

Annual Report 2014-15



Bangladesh Agricultural Research Council

National Agricultural Research System (NARS)

Institute	Ministry	Areas of Research
Bangladesh Agricultural Research Council (BARC), Dhaka	Agriculture	Strengthen the national agricultural research capability through research planning, coordination, integration and resource allocation
Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur	Agriculture	Basic, applied and adaptive research on cereals (other than rice), pulses, oilseeds, vegetables, horticultural crops etc.
Bangladesh Rice Research Institute (BRRI), Joydebpur, Gazipur	Agriculture	Basic, applied and adaptive research on rice
Bangladesh Jute Research Institute (BJRI), Sher-e-Bangla Nagar, Dhaka	Agriculture	Basic, applied and adaptive research on jute production and utilization
Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh	Agriculture	Application on nuclear technology in agriculture
Bangladesh Sugarcrop Research Institute (BSRI), Ishurdi, Pabna	Agriculture	Applied and adaptive research on sugarcrops
Soil Resource Development Institute (SRDI), Farmgate, Dhaka	Agriculture	Soil survey, soil classification and soil characterization
Cotton Development Board (CDB), Khamarbari, Farmgate, Dhaka	Agriculture	Cotton production and research
Bangladesh Fisheries Research Institute (BFRI), Mymensingh	Fisheries and Livestock	Marine and freshwater fisheries research
Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka	Fisheries and Livestock	Basic and applied research on cattle, buffalo, sheep, goats, poultry, duck, etc.
Bangladesh Forest Research Institute (BFRI), Sholashahar, Chittagong	Environment and Forests	Forestry and agroforestry research
Bangladesh Tea Research Institute (BTRI), Srimangal, Moulvibazar	Commerce	Applied and adaptive research on tea
Bangladesh Sericulture Research and Training Institute (BSRTI), Baliapukur, Rajshahi	Textile and Jute	Research and training on sericulture

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Executive Summary

The Annual Report of this year presents the activities of Bangladesh Agricultural Research Council associated with governance, management and development of research programmes in the National Agricultural Research System. Highlights of the progress of the activities during 2014-2015 have been focused in this report.

Governing Body Meeting

The Governing Body meeting was held on 27 February 2013 in the BARC conference room. The meeting directed to explicitly describe the achievements attained by Sponsored Public Goods Research (SPGR) sub-projects so that it gives a clear idea about how the achievements are going to improve the agriculture and the farmers in the country. The meeting expressed satisfaction on the development of digital crop zoning and emphasized on updating it after every five years. The meeting also discussed the enhancement of honourarium of PhD scholars and other allowances for Governing Body, Executive Council, Board of Management of NARS institutes, and seminar/meeting etc.

Executive Council Meeting

The 2nd, 3rd, 4th, 5th, 6th and 7th meetings of Executive Council of BARC were held on 1st August, 7th October and 23rd December of 2012 and 27 February, 11 April and 6th June of 2013 respectively in the BARC conference room. The 2nd meeting discussed the equalization of grading system with the erstwhile class/division system of grading. The meeting formed a Committee to submit a report along with the recommendations. The 3rd meeting discussed the research proposals and budget of Bangladesh Sericultural Research and Training Institutes and Cotton Development Board for approval. It also discussed the matter relating to allowances of training, meeting, rapporteur and expert reviewers of NARS institutes. The 4th meeting

discussed the proposals and budget of research programmes of BARI and BINA, the *Guidelines of Allocation and Management of BARC Research Grants-2013*. The meeting also discussed allowances of training/seminar/workshop participants, guest speaker, farmers, course director and coordinator, session chair, rapporteur, key-note speakers, etc. The Executive Chairman, BARC mentioned the importance of Master Plan for determining future research plan and research priorities. The 6th meeting approved the research proposals and budget of BRRI and discussed the matter relating to enhancement of institutional capacity, operationalization of M&E Cell and MIS database. As per the decision of 2nd meeting, the 6th meeting presented the revised report on equalization of grade with previously class/division system. The 7th meeting discussed and approved the research proposals and budget of BJRI, BLRI, BFRI (Fisheries) and BFRI. The meeting also approved the appointment and promotion of BARC officers.

Project Implementation

The Asian Food and Agriculture Cooperation Initiative

The Asian Food and Agriculture Cooperation Initiative, an initiative of Rural Development Administration (RDA), Republic of Korea, is working with 10 Asian countries to stimulate the sustainable agricultural growth through the international R&D cooperation in agriculture and food sector. As Bangladesh is one of the members of AFACI, BARC initiated the following projects:

Development of Variety, Cropping System Research and Technology Transfer of Major Cereals for Sustainable Food Security in Bangladesh

BARC initiated the coordinated the project in June 2010 involving BARI, BRRI, DAE and

BADC for implementing the project activities. The specific objectives was to develop and evaluate advanced materials for higher yield, tolerant to salinity, submergence, temperature for rice and wheat (where applicable) and to develop participatory research and technology transfer programme for sustainable crop production and to update the knowledge and skills of agricultural professionals through training/visit/study tour/exchange programme.

Collection, characterization, conservation and utilization of Rice, Chili, and Minor Cereals in Bangladesh

This project was started under AFACI support in January 2012 and will be continued up to December 2014. Lack of proper strategies for national plant genetic resource conservation and adequate trained human resources are the major constraints in managing plant genetic resources in Bangladesh. Collection, characterization, conservation, utilization and regeneration of rice, chili and some minor cereals are being conducting by this project in Bangladesh under the financial and technical assistance of AFACI. The specific objectives of this project are: 1) To secure the germplasm of rice, chili and some minor cereals through exploration, collection and regeneration in Bangladesh; 2) To develop management system for PGR for easy access by the users; 3) To secure the sustainable use and conservation of safety back-up of genetic resources in Bangladesh. Bangladesh Agricultural Research Council (BARC), the apex body of the National Agricultural Research System (NARS) is coordinating the project. Two major National Agricultural Research Institutes viz., Bangladesh Agricultural Research Institute (BARI) and Bangladesh Rice Research Institute (BRRI) are working as implementing institutes.

Development of Locally Appropriate GAP Programs and Agricultural Produce Safety Information System of Selected Crops in Bangladesh

Under the technical assistance of AFACI, a 3-years project entitled as *Development of*

Locally Appropriate GAP Programs and Agricultural Produce Safety Information System of selected crops in Bangladesh has been undertaken by BARC with the objectives to 1) introduce advanced GAP programmes for improving the safety of Tomato and Mango; 2) promote national GAP program at farm level and also enhance the national capacity on analytical technique to identify chemical and biological contaminants, and 3) establish the Asian agri-produce safety information network among AFACI member countries for exchanging current food safety issues and useful information such as national standards for primary production and border inspection criteria, pesticides use statistics, outbreak of food borne disease and so on.

Establishment of network and model manual on postharvest technology of horticultural crops in Asia

Under the technical assistance of AFACI, a three years project has been implementing by BARC with the objectives to: 1) build a cooperative system and to integrate practical knowledge targeted at postharvest quality maintenance and food safety of horticultural crops among participating Asian countries; 2) develop concrete actions aimed at resolving the existing problems of the postharvest industry with practical model manual on postharvest handling of Tomato, Cabbage and Mango and 3) enhance food safety and quality of Tomato, Cabbage and Mango by utilizing more efficient postharvest technologies and applicable advanced food safety policies.

SPGR Sub-projects on FSRD

The Sponsored Public Goods Research (SPGR) Coordinated Sub-project on *Farming Systems Research and Development for Farmers Livelihood Improvement* is coordinated by Crops Division, BARC and implemented by BARI, BRRI, BJRI, BSRI, BINA, BLRI, BFRI(Fish) and BFRI. The main objective of the project is to disseminate matured whole farming technologies developed by different NARS organizations to increase farm income and to improve the skills

of the scientists/extension personnel involved in FSRD activities. The project commenced in February, 2012 with a holistic approach that includes the integration of different components of farming systems like crops, livestock, fisheries, agro-forestry and homestead agro-forestry. Different site activities include: site characterization, development of sustainable cropping pattern(s), improvement of existing livestock production systems, improvement of fish production systems, development of homestead vegetables production and agro-forestry systems.

Research Management and Coordination

BARC has been providing research grants to various public organizations since 2004. BARC coordinated the research and technology transfer programmes of the NARS, and Agricultural universities through funding of the core research and human resource development. Further, the Planning and Evaluation division organized frequent review and desk/field monitoring, for its success. An amount of Tk. 140.00 lakhs was provided to the core research programmes.

Monitoring of Programmes/Activities

Nine teams were formed with the scientists of BARC for field monitoring of the research/technologies transfer programs carried out during the period of 2012-13. The teams were assigned to visit and monitor the BARC funded research/technologies transfer programmes implemented by different NARS and associate institutes. The following table presents the team composition, monitoring regions, organization visited:

National Agricultural Technology Project

The PIU-BARC in close collaboration with the agricultural Research Institutes (ARIs) and public universities is implementing Sponsor Good Public Research (SPGR) sub-projects and Enhancement of Research Institutional Efficiency (ERIE) activities to develop demand-driven technologies, promote

sustainable intensification and diversification of agriculture including capacity building of the NARS institutes towards attaining the project objectives.

A concept paper on the project entitled *Adaptation to Climate Change and Rehabilitation of Livelihood in South West of Bangladesh (CLAP)* has been developed for funding from German Development Corporation (GIZ). The German Government has in principle accepted the project concept and the Technical Assistance Project Proposal (TPP) of the project.

Project Development/Project financing

During 2012-13, PIU offered 3 sub-projects totaling 108 in six spells. Considering the initial delay in start the duration of 29 sub-projects of the first stint and 58 in the second have been extended up to December 2013 by the Executive Council of BARC. Some new projects were under process of development. These are (i) Rejuvenation of degraded land, (ii) Enhancement of quality of jute fibre, (iii) Graphical user interface for open source biometric computing, (iv) Development of knowledge bank on fisheries, and (v) Development of knowledge bank on livestock.

Project Implementation

Out of 108, seven sub-projects have been completed as per thematic areas (16 sub-projects are within major crop sub sector, 15 soil and water management, 10 farming system research, 9 Livestock, 7 sub-projects each under the plant genetic resources, fishery and forestry; 6 sub-projects each under the unfavorable ecosystem and food safety, 5 sub-projects each goes to climate change issues and socio-economics, marketing, supply and value chain; and 3 sub-projects each under the farm machinery and productivity, post-harvest technology and ICT in agriculture). Activities and salient features of some of the implemented prospective SPGR sub-projects are briefly discussed below:

Research/Financial Management and Coordination

The PIU-BARC was actively involved in development, implementation, coordination, and monitoring, and reporting of the Sponsored Public Goods Research sub-projects during 2012-13. The key financial management activities of PIU-BARC are maintenance of books and accounts, budgeting, banking operation, fund inflow. Total allocation during 2012-13 was 35.00 crore and expenditure was 31.75 crore, 90.70 % of the allocation.

Monitoring and Evaluation

Continuous desk monitoring of the SPGR sub-projects and ERIE activities has been done since inception to date. Several review meetings and discussion forums on SPGR were organized by the concerned technical divisions and the PIU-BARC. All required assistance by the PIU-BARC provided to the PCU appointed firm on concurrent monitoring and evaluation, and impact assessment (IA).

Fertilizer Technical Sub-Committee

Fertilizer Technical Sub-Committee was formed by the Ministry of Agriculture (MoA) in 1997 to help the National Fertilizer Standardization Committee. Member-Director (NRM), BARC works as the convener and Additional Director (Implementation), DAE as the Member Secretary of the committee. The committee comprises of 19 (nineteen) members with the CSO (Soils), BARC, CSOs of Soil Science Divisions of different NARS institutes, CSO, OFRD; representatives from different concerned organizations like Departments of Environment, Livestock, Fisheries, BSTI, SRDI, BADC, BCIC etc.

Two meetings of Fertilizer Technical Sub-committee were held with Member-Director (NRM) in the chair. A number of organic and chemical fertilizers and PGRs were evaluated in these meetings, among which twenty two (22) organic fertilizers were recommended for

standardization to the National Fertilizer Standardization Committee headed by Secretary, Ministry of Agriculture.

ICT Activities

Computer and GIS unit of BARC is involved in overall ICT management of BARC in view of hardware, software, networking etc. and plays a vital role to establish ICT infrastructure and facilitate ICT and MIS related activities/services among NARS institutes. With the support of National Agricultural Technology Project (NATP), Computer and GIS unit already established a Data Center at BARC which connects 7 NARS institutes through Virtual Private Network (VPN). The development of MIS for NARS is in progress with NATP support. The MIS system once deployed will help identify skill gap, observe research trend in different sub-sector of agriculture, avoid wasteful duplication, apprehend investment trend and identify research capacity including physical facilities among many advantages.

Human Resources Development

During this period, training/workshop/higher study/study visit programmes have been arranged where scientists/officers from the NARS institutes/Ministry of Agriculture participated in the NATP/Revenue funded programs at home and abroad. It may be mentioned that 1523 scientists/officers attended the revenue funded training/workshop/higher study programs while the remaining 3183 scientists/officers participated in the NATP funded training/workshop/higher study/study visit programs at home and abroad. Besides, foreign training/seminar/workshop/meeting in different countries of the globe have been arranged.

In-country PhD

One of the major tasks of Manpower of Training Unit of BARC is to offer higher studies for NARS scientists in various disciplines of agriculture and beyond. During 2008-2009, 18 in-country PhD have been

offered to the scientists of NARS under revenue budget. Almost all the PhD fellows joined their respective institutes upon completion their PhD program for the period of 2009-2012. Meanwhile, fresh applications have been sought from the NARS institutes for the revenue funded in-country PhD Program for the period of 2013-2016.

There was a provision of five slots for in-country PhD under CSISA-BARC Scholarship Program. Three officers- one from BARC and two from BARI are pursuing PhD and remaining two- one from BFRI (fisheries) and other from BINA are under admission process.

In-country PhD (PIU-BARC): NATP Phase-I

During the reporting period 60 PhD scholars are pursuing their courses and research work in different public universities within the country. The PhD scholarships were nominated from among the NARS institutes as BARI-25, BRRI-10, BJRI-7, BSRI-5, BINA-3, SRDI-4, BFRI (fish)-4, BTRE-1 and MoA-1. It may be mentioned here that all of PhD scholars have already completed their courses and most of them completed their field research. In addition, under SPGR sub-projects nineteen scholars are pursuing their PhD degree in different universities in Bangladesh.

Foreign PhD (PIU-BARC): NATP Phase-I

Under the PIU-BARC: NATP Phase-1, 30 slots were earmarked for foreign PhD programs for the scientists of National Agricultural Research System (NARS) and all the selected PhD scholars have taken admission in the universities of different countries like Malaysia, Thailand, China, Philippines, India and Sri Lanka. Some of the scholars have completed their PhD and the remaining will complete their PhD program by 2014.

Foundation Training

The 23rd Foundation Training Course of the National Agricultural Research System (NARS) scientists was arranged at Bangladesh

Academy for the Rural Development (BARD) in Comilla. The course duration was four months from January 23, 2013 to May 23, 2013 in which 40 officers took part. The program was conducted by BARD Comilla and sponsored by Bangladesh Agricultural Research Council. The newly recruited Scientific Officers from different NARS institutes were the participants in this course. The program was financed by PIU-BARC:NATP Phase I.

Administrative and Financial Management

A 14-day Training Program on Administrative and Financial Management was organized at Bangladesh Academy for Rural Development, Kotbari, Comilla with 40 PSOs and CSOs from different NARS institutes. The objective of the training program was to provide these senior level scientists/researchers with the modern concepts of administrative and financial management system.

I. HIGHLIGHTS OF RESEARCH AND DEVELOPMENT

CROPS

PROJECT IMPLEMENTATION

AFACI Project

Development of Locally Appropriate GAP Programs and Agricultural Produce Safety Information System of Selected Crops in Bangladesh

Good Agricultural Practices (GAP) have been developed aiming to modify agricultural practices at farm level for a range of agro-commodities. Demand of safe and high quality food produced under GAP have been increasing in recent years. Many developing countries including Bangladesh are facing challenges in national and international trading under WTO, free trade agreements, multiplicity of governmental GAP standards and private sector requirements. Therefore, implementation of GAP is essential to contribute in agricultural development.

Under the technical assistance of AFACI-GAP supported program, GAP protocol for Mango and tomato have been developed to minimize the risk of hazards occurring during the production, harvesting and post harvest handling that will cover food safety, quality, environmental impacts and health, safety and welfare for workers.

Presently, export of Bangladeshi agricultural products is increasing significantly. A good number of vegetables and fruits are being exported to the ethnic communities in Europe and Middle East from Bangladesh. But Bangladeshi fruits and vegetable produces cannot access to the upstream markets due to absence of globally accepted good agricultural practices (GAP). Fresh vegetables and fruits will be potential export sector and create employment opportunity and improve the livelihood of rural people, if good agricultural practices (GAP) are strictly followed.

Work done in Year II

- Conducted survey for mango and compiled three sets of survey data on mango and tomato.
- Conducted programme planning meetings to review the progress of the target activities. Edited the draft manuals on the target crops (Mango & Tomato).
- Conducted training on GAP concept to scientists, professionals, field level agricultural extension workers and farmers.

- Development of draft GAP manual on focus crops (mango and tomato).
- GAP network with the relevant scientists, officers were developed (initially 35 members were listed with a registration form).
- Attended annual Progress Review Workshop (PI meeting) at Bali, Indonesia, 2014.

Major outcome

- Knowledge and awareness on GAP for fruits and vegetables as well as food safety assurance have been developed;
- GAP manuals of mango and tomato have developed (in press) in both English and Bengali first time in Bangladesh and using as base materials for trainings and others activities by different stakeholders;
- GAP network in Bangladesh have developed first time with 35 professionals in and create huge interest on GAP;
- GAP professionals have developed through training on 'GAP concept & principles for fruits & vegetables production' and farmers and field level extension were trained in the target areas on the focus crops;
- Training lecture on GAP concept and principles have been developed both English and Bengali which is using in different training programme for farmers and professionals;
- Technical knowledge and skills developed from this project on GAP is being sharing with other stakeholders for developing GAP activities and projects.

Conclusion

- This project is the very good start for GAP in Fruits and vegetables in Bangladesh. GAP manuals will be used in field level to ascertain safe production and support export of fresh fruits and vegetables.
- More manuals on other products/crops will be developed with knowledge and skill developed from this project.
- Large scale training need to be provided to farmers, extension workers, producers, traders and exporters to adopt GAP protocol in practice.
- GAP certification agency need to be developed in Bangladesh.

Collection, characterization and utilization of rice, minor cereals and chili in Bangladesh

A Pan Asian project *Integrated Management System of Plant Genetic Resources (IMPGR)* under the financial assistance of Asian Food & Agriculture Cooperation

Initiative (AFACI) has been implementing in its eleven member countries since January 2012. As a member of AFACI, Bangladesh is also implementing a project entitled *Collection, characterization and utilization of rice, minor cereals and chili in Bangladesh* under IMPGR project. The Specific objectives of this project are: i) to secure the germplasm of rice, minor cereals and chili through exploration, collection and regeneration in Bangladesh; ii) to develop management system for PGR for easy access by the users; iii) To secure the sustainable use and conservation of safety back-up of genetic resource in Bangladesh. BARC is acting as coordinating agency while BARI and BRRI as implementing organization. This project completed in December 2014. The overall achievements of the project are as follows:

Collection: A total of 392 germplasm of 8 crops (152 rice, 204 chili, 27 foxtail millet, 5 barley, 1 finger millet, 1 barnyard millet, 1 buckwheat and 1 proso millet) have been collected from 60 upazilas (sub-district) of 23 districts.

Regeneration: A total of 191 collected germplasm of five crops (51 rice, 120 chili, 18 foxtail millet, 1 barley, and 1 barnyard millet) have been regenerated. Sufficient seeds having >80% germination were obtained from 51 accessions of rice, 17 accessions of chili, 18 accessions of foxtail millet, 1 accession of barley and barnyard millet.

A total of 239 accessions of three crops (foxtail millet 130, barley 46, and proso millet 63) were regenerated.

Characterization: A total of 205 collected germplasm of four crops (rice 79, chili 120, foxtail millet 5 and barley 1) have been characterized morphologically. Twenty two qualitative and five quantitative characters were recorded for chili following the descriptors of IBPGR (1983). In case of rice, 29 qualitative and 19 quantitative characters were recorded following the

descriptors of BRRI (1993).

Minor cereals germplasm of base collection those were not characterized have been characterized during this project period. A total of 229 accessions of three crops (barley 49, foxtail millet 130 and proso millet 50) were characterized. Sixteen qualitative and 7 quantitative characters for barley, 15 qualitative and 9 quantitative characters for foxtail millet, 11 qualitative and 7 quantitative characters for proso millet were recorded following the descriptors of each crop [IBPGR, 1982; IBPGR, 1983, IBPGR, 1985 (a) and IBPGR, 1985 (b)]

Conservation: Collected and regenerated PGR have been conserved in active and/or base collection of GRS division, BRRI and PGRC, BARI. Temperature in active collection is 4 to 6°C, and in base collection 18 to 22°C. Moisture content of conserved seeds was less than 8%.

Assessment: Yielding ability and some quality parameters of collected germplasm were investigated during characterization. Several promising lines and desirable traits were identified.

Collection, Characterization and Promotion of Rice, Chili, Cucumber and Melon in Bangladesh

A Pan Asian project *Integrated Management System of Plant Genetic Resources (IMPRG)* under the financial assistance of Asian Food & Agriculture Cooperation Initiative (AFACI) has been implementing in its eleven member countries for three years, 2015-2017 starting from January 2015. As a member of AFACI, Bangladesh is also implementing a project entitled *Collection, Characterization and Promotion of Rice, Chili, Cucumber and Melon in Bangladesh*. BARC is acting as coordinating agency while BARI and BRRI as implementing organization. The progress on exploration and germplasm collection from different districts is shown below:

Collection of Chili, cucumber and melon germplasm from different districts in Bangladesh during 2014-15

District	No. of upazilas explored	No. of germplasm collected			
		Chili	Cucumber	Melon	Total
1. Manikganj	4	15	2	2	19
2. Munsiganj	2	7	4	3	14
3. Pirojpur	2	8	0	2	10
4. Jhalokathi	2	8	3	0	11
5. Barisal	2	4	0	0	4
6. Madaripur	2	6	0	1	7
7. Shariatpur	2	7	0	2	9

8. Kishoreganj	3	12	0	0	12
9. Dinajpur	1	4	3	0	7
10. Panchagarh	1	1	2	0	3
11. Bogra	1	2	1	1	4
12. Dhaka	6	36	2	111	149
13. Gazipur	5	84	9	50	143
14. Khagrachari	3	8	9	9	26
15. Rangamati	1	0	1	0	1
16. Feni	1	1	0	0	1
Total	38	203	36	181	420

Progress on Characterization of Collected Germplasm

i) Morphological characterization and evaluation of chili

The experiment has been conducted at PGRC, BARI, Gazipur with 85 germplasm of chili collected during last year of the first phase of the project. Out of 85 germplasm 75 were morphologically characterized.

ii) Morphological characterization and evaluation of cucumber

The experiment has been conducted at PGRC, BARI, Gazipur with 56 cucumber genotypes which was in flowering and fruiting stage.

Molecular characterization of chili germplasm

Molecular characterization of 100 chili germplasm collected during last year of first phase of the project are being conducted at Molecular Biology Laboratory, PGRC, BARI, Gazipur.

Regeneration of chili germplasm

The experiment has been conducted at PGRC, BARI, Gazipur with 88 germplasm of chili collected during first phase of the project (2012-14) for characterization and evaluation of the germplasm.

Regeneration of cucumber and melon germplasm

The experiment have been conducted at PGRC, BARI, Gazipur with 10 collected germplasm of cucumber and 11 newly collected germplasm of melon.

Evaluation of chili germplasm against *rhizoctonia solani*

The experiment has been conducted at PGRC, BARI, Gazipur with 65 germplasm of chili collected during last year of the first phase of the project. Fourteen germplasm showed highly resistant reaction while 17 germplasm showed moderately resistant reaction against the pathogen.

Besides, Genetic Resources and Seed Division of BRRI collected 22 germplasm from Narsingdi, Manikganj, Dhaka, Munshiganj, Jhalakathi, Pirojpur districts of Bangladesh through direct collection approach. The collected germplasm stored in short term storage of BRRI genebank. Inaddition 31 previously collected rice germplasm were in the field for regeneration, characterization and assessment.

Establishment of network and model manual on postharvest technology of horticultural crops in Bangladesh (September 2012 to October 2015)

The project is going on properly. Both Tomato and Cabbage manual in English and Bangla draft have been developed. Postharvest activities of Cabbage in Bangladesh has been included in a book entitled *Postharvest Handling of Cabbage and Chili Pepper in Asia* published by Korea in October, 2014. To correct the draft manuals on tomato and cabbage both in English and Bangla four Expert Consultation meeting were conducted. Postharvest related scientists and experts from BARI, BAU, SAU, Hortex Foundation and scientists of Crops Division, BARC were actively attended in the meetings. Finally the two books were ready for publication in next financial year 2015-16 within the project period.

A two day training program on *Postharvest technology of horticultural crops* was conducted during 09-10 December 2014. Fifty participants from NARS institutes, BADC, DAE, Hortex Foundation and several private organizations were participated in the training program. The concern experts and scientist delivered their lectures on different aspects of postharvest technologies in Bangladesh.

A list of 55 Postharvest related scientists, extension workers and experts have been documented and sent to Korea for Network development by the project. We expect that these two manuals will be very effective to

reduce the postharvest loss significantly of horticultural crops in Bangladesh.



Activities of Training Program of Postharvest Technology in Horticultural Crops

Implementation of Good Agriculture Practices in SAARC Countries: SAARC GAP Scheme in Bangladesh

Primarily increasing food safety hazards as created the need to promote safe and healthy food. The production of safe food is essential for protecting consumers from the hazards of food borne illnesses and is important both in the domestic food business as well as for increasing competitiveness in export markets. Hazards In food may be introduced at different stages of the food chain starting right from the primary production stage. Examples include residues above permitted levels, microbial contaminants, and heavy metals. It is important to address food safety right from production at farm level. Therefore, implementing GAP (Good Agricultural Practices) during on-farm production and post production processes is of paramount importance for sustaining safe food supply.

GAP is defined by FAO of United nations as “collection of principles to apply for on-farm production and post production process, resulting in safe and healthy food and non-food agricultural product, while taking into account economic, social and environmental sustainability”.

In SAARC many of the countries have not adopted GAP and do not even have an institutional infrastructure for supporting the same in terms of standards, as well as their implementation, certification and accreditation. The GAP standard has been developed in relation to food safety and quality, environmental management and worker’s health, safety and welfare modules besides general modules, based on

SAARC GAP scheme promoted by FAOAPR (FAO Asia-Pacific Region) on a pilot basis, initially covering four countries viz., Bangladesh, Bhutan, Nepal and Maldives.

The entire scope of SAARC scheme was discussed minutely in the regional workshop conducted in Dhaka during September 2014, participated by seven (7) out of eight (8) SAARC countries. This was followed by one day consultative meeting for all stakeholders of Bangladesh on 25 September 2014 at Dhaka; wherein a decision was taken to take the scheme forward and internalize with Bangladesh GAP requirements and an action plan drawn for implementation of GAP standard. The implementation of SAARC GAP scheme and its internalization was formulized in a technical agreement executed by FAO and Government of Bangladesh during July 2014.

Later on the governing structure of Steering Committee (SC), Technical Committee (TC) and Certification Committee (CC) internalize the grounding of the scheme with timeline of February 2016.

The services of National Project Coordinator (NPC), International Consultant (IC) and National Consultant (NC) were commissioned resulting in the conclusion of the first phase of the GAP implantation in the shape of conducting the first Steering Committee (SC) meeting on 09 March 2015; Technical Committee (TC) meeting on 23 March 2015 and Certification Committee (CC) meeting on 14 April 2015. The outcome of the three meetings resulted in internalizing the SAARC GAP scheme, culminating in the generation of Bangla GAP standard.

National and International Linkages

Highlights of activities undertaken under MoU/Bilateral Agreement, Collaborative Workplan signed during the period:

- A report on *Bangladesh-Thailand 6th Joint Economic Commission* held on 2-4 November 1998, Bangkok, Thailand was sent to MoA on 8 July 2013.
- Opinion on establishment of bilateral relationship between Bangladesh and EMBRAPA with tentative budget was sent to MoA on 21 July 2013.
- Opinion made on draft MoU between Bangladesh and Zambia for agricultural cooperation and sent to MoA on 27 September 2013.
- Brief & Talking points prepared and sent to MoA for 2nd Senior Officer Level Meeting to be held in South Africa on 25-26 November 2013 on 6 November 2013.

- Draft MoU between Ministry of Agriculture/BARC and Republic of Guinea for bilateral cooperation in the field of agriculture was prepared and sent to MoA on 30 September 2013.
- Draft MoU between Bangladesh and Kuwait for bilateral cooperation in the field of agriculture was made and sent to MoA on 19 August 2013.
- The MoU between Bangladesh and Cambodia for bilateral cooperation in the field of agriculture was signed on 17 June 2014 at Honble Prime Minister's office, Dhaka.
- Draft MoU between Bangladesh and Malaysia was prepared and sent to MoA on 10 November 2013.
- Training proposal at Malaysian Agriculture Research and Development Institute (MARDI) was sent to MoA on 31 December 2013 for the implementation of decisions of 3rd Joint Commission Meeting between Bangladesh-Malaysia.
- Opinion made on "Prospects of Grape & Saudi Date palm cultivation in Bangladesh for Bangladesh Bank" was sent to MoA on 7 November 2013.
- Brief & Talking points prepared for 11th Joint Economic Commission Meeting between Bangladesh and Saudi Arabia to be held in Dhaka, Bangladesh on February 2014 and sent to MoA on 22 January 2014.
- Inputs made for forthcoming bilateral meeting between Bangladesh and the Philippines to be held in Manila, Philippines during January, 2014 and sent to MoA on 27 January 2014.
- Inputs made for forthcoming bilateral Safety dialogue between Bangladesh and Myanmar and sent to MoA on 27 January 2014.
- Inputs made for forthcoming 5th JEC between Bangladesh and Iran to be held during 5-6 May 2014 and sent to MoA on 2 February 2014.
- Commented on Progress on Bangladesh-Iran 5th Joint Economic Commission Meeting and sent to MOA on 6 February 2014.
- Commented on the proposed MoU between Bangladesh and Chile on Sanitary and Phytosanitary Matters & sent to MoA on 2 March 2014.
- Prepared draft MoU between Bangladesh and South Africa and sent to MoA on 29 April 2014.
- Opinion given on draft Agreement on Bangladesh-Indonesia Scientific and technological cooperation and sent to MoA on 4 May 2014.
- Opinion made on proposed MoU between Bangladesh and Chile on "Sanitary and Phytosanitary Matters" and sent to MoA on 4 May 2014.
- Inputs given for 8th Annual Foreign Ministerial Review Meeting between Bangladesh and Myanmar in the Field of Agriculture and sent to MoA on 18 May 2014.
- Inputs given for discussion during visit of Indian Foreign Minister and sent to MoA on 17 June 2014.

Regional and International Collaboration & Cooperation

i. South Asia Agricultural Science and Technology Training

South Asia Agricultural Science and Technology Training Class hosted by Yunnan Provincial Science and Technology Department, organized by Yunnan Academy of Agricultural Sciences, Kunming, China during 11-25 August 2014. A three members delegate from BARC including Dr. S. M. Khorshed Alam, PSO (Crops) was participated in the program. Under The Exchange and Cooperation Consortium for Agricultural Science and Technology, China - South Asia (ECCAST-CSA) platform, four MoUs on (i) Wheat, (ii) Upland Rice, (iii) Sugarcane and (iv) Plant Protection were signed on 21 August 2014 with Yunnan Academy of Agricultural Science (YAAS), Kunmimg, China and Bangladesh Agricultural Research Council (BARC) during the visit.

ii. Training on Analytical Techniques used in nutrition, food safety and biosafety

The training program was held at ICRISAT, India on 31.08.15 to 14.09.15. Dr. Md. Abdus Salam, PSO (Crops) attended this training. Hands on training received on Analytical Techniques used in nutrition, food safety and biosafety.

iii. Second Annual South Asia Biosafety Conference

Two days conference was held during 15-16 September 2014 in Sri Lanka. The theme of the conference was *Transgenic crop development and Biosafety regulations in South Asian Countries*. Dr. Md. Aziz Zilani Chowdhury, CSO (Crops) was attended in the conference and presented a paper on *Current status of research and development of Genetically Engineered Plants in Bangladesh*.

iv. FAO funded project *Enhancing Understanding and Implementation of the International Treaty on Plant Genetic Resources for Food and Agriculture in Bangladesh*

- A day long inception workshop *Workshop for Finalization of PGRFA Strategic Plan* was arranged on 09 March 2015 with a view to develop strategic Plan. Thirty participants from BARI, BRRI, BJRI, BSRI, BINA, SAU, BSMRAU, LalTeer Seed Ltd., and BARC were attended in the workshop.
- A day long Training Workshop on *Multilateral System (MLS) Incentives and Disincentives* was arranged on 21 June 2015 with the objective to create awareness regarding the importance of plant genetic resources, mutual transfer and its utilization. Eighteen participants from BARI, BRRI, BJRI, BSRI, BINA, CDB, SAU, LalTeer Seed Lt. and BARC were attended in the workshop.

v. Fourth Meeting of BIMSTEC Expert Group on Agricultural Cooperation

Fourth BIMSTEC Expert Group Meeting was held in Kathmandu, Nepal during 6-7 April 2015. As a Focal Point of Bangladesh, Dr. Md. Aziz Zilani Chowdhury, CSO (Crops) attended the meeting. The Project proposal of Bangladesh on *Strengthening of Food Security Information System and its Networks among BIMSTEC Member Countries* was appreciated by the member states. He also presented a paper on *Current Trend/Progress of Agricultural Sector in Bangladesh*.

vi. Final meeting of the project *Enhancing understanding and implementation of the International Treaty on Plant Genetic Resources for Food and Agriculture (PGRFA) in Asia*

Dr. Md. Abdus Salam, PSO (Crops) attended the meeting in Thailand during 22-24 April, 2015 and presented the final project report.

vii. 3rd AFACI International Training Workshop on Germplasm Management System at RDA, Korea

Third AFACI International Training Workshop on Germplasm Management System at RDA, Korea was held on 11 May to 20 May 2015. Dr. Md. Abdus Salam, PSO (Crops) attended this training. PGR Management by Molecular Techniques and

Cryopreservation Techniques were discussed in this program.

Some important activities and policy support by crops division are as follows:

- Two meetings of National Technical Committee on Crop Biotechnology were held on 15-7-2014 & 12-8-2014 for evaluation of BARI proposal for Late Blight Resistant potato in confined trial for inclusion of non-transgenic cathadin (parent).
- Under the MoU between BARC and SLCARP, Comments on Joint Working Group for visiting Sri Lanka has been sent to MoA on 21-07-2014.
- Inputs for 8th Annual Foreign Ministerial Review Meeting between Bangladesh and Myanmar in the Field of Agriculture was prepared and sent to MoA on 3 August 2014.
- Opinion sent to MoA on 3 August 2014 on Stockholm Convention on Persistent Organic Pollutants (POPs).
- DPP of Vertebrate Pest Division of BARI & Entomology Division of BSRI reviewed and submitted to MoA on 6 August 2014.
- Dr. S.M. Khorshed Alam. PSO (Crops) participated in “South Asia Agricultural Science and Technology Training Class” hosted by Yunnan Provincial Science and Technology Department, organized by Yunnan Academy of Agricultural Sciences, Kunming, China during 11 August to 25 August 2014.
- A meeting of National Technical Committee on Crop Biotechnology was held on 21-09-2014 for evaluation of Golden Rice Research (pro-vitamin enriched) of BRRI.
- Prepared three papers for Food Minister on 1. Side Event, “Food Crops for a Changing Climate” at the Secretary General’s Climate Change Summit (22 September 2014, 13.15-14.30 hrs) 2. High-Level Workshop, “Food Crops for Agriculture in a Changing Climate: an Expert Communiqué” (22 September 2014, 15.00-18.00 hrs) and 3. Fourth High-Level Ministerial Round Table, “International Treaty, Climate Change and Food Security” ((24 September 2014, 11.00-13.00 hrs) and sent to MoF on 15 September 2014.
- Brief on the progress of the decision of the 4th JEC between Bangladesh and Sri Lanka has been sent to MoA on 30-09-2014.
- Brief on the progress of the decision of the 4th JEC between Bangladesh and Sri Lanka has been sent to MoA on 16-10-2014.

- Information Related to the Ministry of Agriculture for inclusion in the Speech of Hon'ble President will be delivered in the 1st session of 10th National Parliament in English Version has been sent to MoA on 22 October 2014.
- BARC's comments sent to Ministry of Agriculture on 23 November 2014 for Import of Jackfruit grafts (Kolom) from Malaysia following quarantine rules.
- BARC's comments on "Tea cultivation and green leave production (চা শিল্পের ৬০% অংশকে কৃষি কাজে ব্যবহারের জন্য। (25-11-2014)
- Comments of BARC has been sent to MoA on Lac, its characteristics and uses on 25-11-2014.
- Comments of BARC have been sent to MoA on Draft Medical Biotechnology Commission Act 2014 on 02-12-2014.
- Comments of BARC have been sent to MoA on Draft Jute Act 2014 on 04-12-2014.
- Comments of BARC have been sent to MoA on 17-12-2014 on the Development of Project Proposal for Strengthening Research Activities of BRRI.
- Information regarding the implementation of MoU between Bangladesh and Sri Lanka has been sent to MoA on 18-12-2014.
- Report headed by "Information required to Initiate the Pest Risk Analysis" sent to MoA on 21-12-2014 regarding export of Sesame Seeds as per desired format of Mexican company.
- Commented on draft MoU between Bangladesh-Uganda and sent to MoA on 28 October 2014.
- Participated in the 99th Sub-PTAC Meeting held at DAE on 28 December 2014.
- For export of Maize and sesame, information/data has been collected and comments sent to MoA on 01-01-2015.
- Comments of BARC have been sent to MoA on 12-01-2015 on the Concept Note on Capacity Development for Agricultural Innovation System.
- Comments/opinion made on MoU between Bangladesh and Brunei and sent to MoA on 9 February 2015.
- Comment/opinion made on "Details of the thirty-eighth session of the Governing Council 16-17 February 2015 and sent to MOA.
- Opinion given on date fixation for signing of Work Plan between BARC and SLCARP on the basis of MoU between the two countries and sent to MoA on 17 February 2015.
- Commented on draft Quarantine rules 2015 and given to Executive Chairman, BARC on 23 February 2015.
- Corrected draft MoU between Bangladesh and Brunei and send to MoA on 26-02-2015 through e-mail & hard copy.
- Opinion sent to MoA on 3 March 2015 on Stockholm Convention on Persistent Organic Pollutants (POPs) on request of Ministry of Environment and Forestry.
- Updated the Concept Paper on "Strengthening of Food Security Information System and its Networks among BIMSTEC Member Countries" and sent to MoA on 18 March 2015.
- BARC's comments on উন্নয়নের পথ নকশা: বাংলাদেশ চা শিল্প নিবন্ধ has been sent to MoA on 19-03-2015.
- Prepared concept paper on Bangladesh-Japan Joint Working Group and sent to MoA on 2 April 2015.
- Proposed workplan between BARC and SLCARP has been sent to MoA on 02-04-2015.
- Commented/opinion made on MoU between Bangladesh-Chile on Sanitary and Phytosanitary Matters and sent to MoA on 2 April 2015.
- National Crops and Forest live Technology Directory 2012 was revised and sent to MoA on 05-04-2015.
- Inputs for Foreign office consultation between Bangladesh and Sri Lanka have been sent to MoA on 07-04-2015.
- ACI proposal on research and seed production of BT brinjal was evaluated on 18-05-2015.
- To be done on the basis of Third of Foreign Office Consultation (FOC) between Bangladesh and Sri Lanka sent to MoA on 24-05-2015.
- Comments of BARC on the Minutes of Bangladesh and Nepal Additional/Joint Secretary level meeting to be held in Katmandu, Nepal (22-24 August, 15) was sent ot MoA on 25-05-2015.
- DU proposal on Contained Research Work on GM rice (salt tolerant) was evaluated on 28-05-2015.
- Participated in the 100th Sub-PTAC Meeting held at DG's Conference Room of DAE on 11 June 2015.
- জলবায়ু পরিবর্তন জনিত প্রেক্ষাপট ও ক্রমবর্ধমান জনসংখ্যার বিপরীতে পর্যাপ্ত খাদ্য শস্য উৎপাদন ও পুষ্টি নিরাপত্তা বিষয়ে BARC's comments sent to MoA on 25-06-2015.
- For implementation of the MoU between BARC and Sri Lanka proposed workplan has been sent to MoA on 28-06-2015.
- Prepared Training Manual on "Agricultural Technologies for Adaptation to Climate Change"
- Comments on MoU between Tanzania and Bangladesh
- Comments on the DPP for 'Enhancement of Pulses Research and Development in Bangladesh'

- Translation from Bengali to English of a letter of Finance Ministry entitled “Agricultural Land Lease in African countries”
- Translation from Bengali to English “Information related to Ministry of Agriculture for Inclusion to the Speech of Hon’able President will be Delivered in the 1st Session of the 10th Nation Parliament 2015.

Monitoring of the Research Programme

As a team member (formed by Planning and Evaluation division, BARC) the scientists of crops division have visited one BJRI project in May 2015 at field level implemented under research grant fund of BARC. As a member of the monitoring team the Member Director (Crops) also evaluated the projects at Sher-e-Bangla Agriculture University, Dhaka.

TECHNOLOGY TRASFER MONITORING UNIT

Every year, a good number of technologies have been generated by the National Agricultural Research System (NARS) institutes. For maintaining food security, proper transfer activities of these technologies are very important. For field level adoption, TTMU is working to facilitate the activities of transfer of technology to the Department of Extension (DAE), private and public organizations, Non Government Organizations (NGO) etc. TTMU is also working to strengthen the linkages among research, extension and farmers. Recently, TTMU has taken an initiative to find out the limitation of the NARS institutes in transferring technologies properly and in this regards BARC formed a committee where Director TTMU acts as Member Secretary.

On this background, according to Work-plan 2014-15,

TTMU has organized one workshop, five trainings and two meetings. Four Training of Trainer (TOT) were conducted at out-side and only one was at BARC, Dhaka. Around 120 field level Officers and 120 Agricultural Officers (SAAO) were trained for mango and Potato crops. Around 250 participants including DAE officers (around 100), researchers, academia, private seed companies, NGO workers and farmers were participated in the 2-day long national workshop. The honorable Minister, Matia Chowdhury, MP was attended as the Chief Guest in the workshop. Around 350 innovative technologies of crops, livestock, fisheries and forest was presented by the respective NARS institutes. A book covering all these technologies are in progress for printing. The details activities conducted by TTMU during 2014-15 have described below:

Policy Level Contribution

Scientists of TTMU participated in Policy Meeting on:

1. *NARS and Comprehensive Policy Planning of NARS* on 07 March 2015, BARC, Dhaka.
2. *The World Bank Scoping Mission for Agriculture Insurance* on 25 Nov 2014, BARC, Dhaka.
3. *Opinion Exchange on Agricultural Development* with Visitors from Botswana, during 20-22 December 2014, BARC, Dhaka.

Monitoring and Evaluation of Programs/Activities of NARS Institutes

Dr. Fauzia Yasmin, PSO, TTMU participated in the field monitoring of core research program during 12-13 June 2015 in the following projects:

Sl.no.	Project Title	Place and Date of Monitoring	Major Observation
1.	Molecular characterization of <i>B. anthracis</i> isolated from the field cases of Bangladesh and selection of vaccine candidates (Livestock)	BAU, Mymensingh, 12-6-2015	DNA samples were extracted from 14 isolates. PCR has been conducted with 14 positive isolates isolated during previous year. Both pX01 and pX02 plasmid containing <i>B. anthracis</i> are prevailing in Bangladesh. 164 bp fragment from pX01 plasmid and 287 bp fragment from pX02 plasmid were amplified.

2.	Production of algae to use as environment friendly feed supplements for poultry (Livestock)	BAU, Mymensingh, 12-6-2015	Cage preparation, designing, feed formulation already conducted. Day old broiler birds will be arrived on 11 th June 2015.
3.	Study of reproduction endocrinology of Mud Eel <i>Monopterus cuchia</i> for artificial propagation (fisheries)	BAU, Mymensingh, 12-6-2015	Breeding success was obtained in all ratios but best was in case of 1:1 ratio (observing the number of spawn). Cuchia spawn were collected from breeding pit in early June 2015.
4.	Improved detection, monitoring and management of two major beetle pests in stored grain through use of multispecies lure and reduced risk insecticide (crops)	BAU, Mymensingh, 12-6-2015	Small scale on-farm validation of developed IPM technologies is in progress at the farmers' storage in Mymensingh region.
5.	Collection and molecular characterization of brinjal and mango plant genetic resources-two important geographical indication (GI) crops of Bangladesh (crops)	BAU, Mymensingh, 12-6-2015	i. DNA of 30 germplasm of mango (out of 34 above) has been isolated and ready for doing the SSR work ii. DNA of 50 germplasm of brinjal (last year) has been isolated and ready for doing SSR work
6.	Resistant breeding for salinity stress tolerance in rice (crops)	BAU, Mymensingh, 12-6-2015	The most salinity tolerant genotypes were RC 227, RC 229, RC 191, Binadhan8, Binadhan10 and FL-478. The most susceptible genotypes were Binadhan7 and BRRI dhan39.
7.	Development of sustainable technologies for improving nutrient and water use efficiency in rice production (crops)	BAU, Mymensingh, 12-6-2015	Sample for both soil and grain has been sent to the laboratory for chemical analysis (On going)
8.	Increasing nitrogen use efficiency through nitrogen and water management in the rice-rice cropping pattern (crops)	BAU, Mymensingh, 12-6-2015	Two interlinked field experiments were done in the Soil Science Field Laboratory, BAU, Mymensingh. Nitrogen use efficient BRRI dhan29 was used as test crop in fertilizer trial and water management experiments. The crops were harvested at full maturity. The yield data showed use of USG had higher nitrogen use efficiency compared to prilled urea.
9.	Development of onion, ginger and garlic mutant varieties through induced mutation (crops).	BINA, Mymensingh, 13-6-2015	At current season mutant screening experiment of ginger is running at the field of char land nearby BINA HQ farm. Mutant screening experiment of onion and garlic will be conducted in the next year.

Project Evaluation

The Development Project Proposal (DPP) entitled *Improvement on Indigenous Floating Agriculture System in Bangladesh* of BARI was evaluated on June 2015.

Training of the Trainers

TTMU has conducted four Training of the Trainers (ToT) programmes in different institutes covering mango and potato. The brief on the ToT programme are as follows:

Production Technology of Mango for Officers, DAE

A day long training programme on newly developed technologies on mango with the emphasis on Good Agricultural Practices (GAP) was organized by TTMU, BARC on 1 June 2015 at Fruit Research Centre, BARI, Binodpur, Rajshahi. The objective of the training programme was to update the knowledge and skill on production technology and GAP for mango to the districts and Upazilla level Agricultural Officers. Forty Officers of DAE from Rajshahi, Chapainowbabgonj and Natore were attended in the training programme. Scientists of BARI and BARC delivered lecture on modern production technology, insect and pest control management, disease management, post-harvest management and GAP for mango. In the inaugural session of the training Dr. Mian Sayeed Hassan, Director (TTMU), BARC and course director was attended as Chief Guest and Dr. Md. Alim Uddin, PSO, Fruit Research Centre, BARI, Binodpur, Rajshahi was the special guest. Dr. Md. Safiqul Islam, CSO, RHRC, BARI, Chapainowbabgonj, chaired the inaugural session of the training programme. Dr. Fauzia Yasmin, PSO (TTMU) coordinated the training programme.

Production Technology of Mango for Sub Assistance Agriculture Officers (SAAO), DAE

Similar day long training programme on newly developed technologies on mango with the emphasis on Good Agricultural Practices (GAP) was organized by TTMU, BARC on 2 June 2015 at RHRC, BARI, Chapainowbabganj. The objective of the training programme was to update the knowledge and skill on

production technology and GAP for mango to the Sub Assistance Agriculture Officers (SAAO), DAE. Forty SAAO of DAE from Rajshahi, Chapainowbabgonj and Natore were attended in the training programme. Scientists of BARI and BARC delivered lecture on modern production technology, insect and pest control management, disease management, post-harvest management and GAP for mango. In the inaugural session of the training Dr. Mian Sayeed Hassan, Director (TTMU), BARC and course coordinator was attended as Chief Guest and Dr. Md. Alim Uddin, PSO Fruit Research Centre, BARI, Binodpur, Rajshahi was the special guest. Dr. Md. Safiqul Islam, CSO, RHRC, BARI, Chapainowbabgonj, chaired the inaugural session of the training programme. Dr. Fauzia Yasmin, PSO (TTMU) coordinated the training programme.

Potato Storage in Traditional Method for Officers, DAE

A day long training programme on “Potato Storage in Traditional Method” was organized by TTMU, BARC on 7 June 2015 at Tuber Crops Research Sub-centre, BARI, Munshigonj. The objective of the training Programme was to update the knowledge and skill of Agricultural Officers on potato storage. Forty Agricultural Officers’ of DAE from Munshigonj, Comilla, Chandpur, Dhaka, Manikgonj, Narayangonj and Tangail attended the training Programme. Scientists of BARI and BARC delivered lecture on modern production technology, insect and pest control management, disease management, post-harvest management and storage of potato. Md. Aminuzzaman, Director (Manpower & Training), BARC was attended as Mr. Nizam Uddin Ahmed, SSO, Tuber Crops Research Sub-centre, BARI Munshigonj chaired the inaugural session of the training programme. Dr. Fauzia Yasmin, PSO (TTMU) coordinated the training programme.

Potato Storage in Traditional Method Sub Assistance Agriculture Officers (SAAO), DAE

A day long training programme on “Potato Storage in Traditional Method” was organized by TTMU, BARC on 8 June 2015 at Tuber Crops Research Sub-centre,

BARI, Munshigonj. The objective of the training Programme was to update the knowledge and skill of Agricultural Officers on potato storage. Forty Agricultural Officers' of DAE from Munshigonj, Comilla, Chandpur, Dhaka, Manikgonj, Narayangonj and Tangail attended the training Programme. Scientists of BARI and BARC delivered lecture on modern production technology, insect and pest control management, disease management, post-harvest management and storage of potato. Dr. Mian Sayeed Hassan, Director (TTMU), BARC and course director was attended as Chief Guest and Mr. Nizam Uddin Ahmed, SSO, Tuber Crops Research Sub-centre, BARI Munshigonj chaired the inaugural session of the training programme. Dr. Fauzia Yasmin, PSO (TTMU) coordinated the training programme.

Production Technology of Major crops for Agriculture Officers, DAE

A 3-day long training programme on technologies of major crops was organized by TTMU, BARC during 16-18 June 2015 at BARC, Dhaka. The objective of the training programme was to update the knowledge and skill on the newly developed technologies of major crops for field level DAE Officers. Forty one Agricultural Officers' of DAE from five region of Dhaka, Mymensingh, Comilla, Faridpur, Jessore, were attended in the training Programme. A total of thirteen lectures were on newly developed variety, production technology including disease and insect management, resource conserving technologies of rice, wheat, maize, pulses, oilseeds, fruits and vegetables were included in the training programme. Scientists of NARS institutes delivered lectures on the training course . Dr. Md. Aziz Jilani Chowdhury, Member Director, BARC, Dhaka was chaired the inaugural session and Dr. Abul Kalam Azad, Executive Chairman, BARC Dhaka was the Chief Guest in both the inaugural and concluding session of the training programme. Dr. Mian Sayeed Hassan, Director (TTMU), BARC was course director and Dr. Fauzia Yasmin, PSO (TTMU) coordinated the training programme.

Meeting of Progress Review of the Technology Transfer and Dissemination

TTMU organized 2 meetings on *Progress Review of the Technology Transfer and Dissemination*

Transfer and Dissemination on 31 January and 20 April, 2015 at BARC with the presence of Mr. Sanot Kumer Shaha, Joint Secretary (Research) and Dr. Abul Kalam Azad, Executive Chairman, BARC presided over the meetings. The status of the NATCC and ATC was updated by Dr. Mian Sayeed Hassan, Director (TTMU), BARC. Dr. Hassan also informed that the last 41th meeting of NATCC was held at 2008 and after that no meeting was held due to various reasons mainly lack of funding for organizing the meeting. The participants of BARC, DAE, BADC, AIS, SCA, NARS raised their voices to organize this type of meeting regularly. To transfer the newly developed technologies and to make bridge with the Research-extension-farmers-market linkage in bottom up approaches, the meeting of NATCC and ATC is very much urgent. Shortly, TTMU took all out efforts to reorganize this meeting. To include in DAE's ongoing technology dissemination programme, a total of 65 recent developed technologies of BARI (23), BRRI (21), CBD (5) and BFRI-Forest (16) have already sent to DAE; besides the NATCC activities.

Workshop, Training, Seminar, Meeting etc attend

During July 2014 to June 2015 Officers of TTMU has attended a good number of Workshops, Seminars and Meetings in home and abroad. Some of the important events of Dr. Mian Sayeed Hasan, Director (TTMU) are listed below:

- i. Presented project report in the Principal Investigator (PI) workshop of AFACI GAP project organized by AFACI at Bali, Indonesia during 19-23 Aug 2014.
- ii. Presented Country report on Background, Introduction and Overview of the Project Development of Standards and Scheme for Good Agriculture Practice (GAP) Implementation and Certification in Bangladesh in the Regional Consultation workshop on "Implementation of Good Agricultural Practices in SAARC Countries: SAARC GAP Scheme" organized by FAO Regional Office for the Asia and Pacific in Collaboration with SAARC Agriculture Centre,

- Bangladesh during 22-23 Sept, 2014, Dhaka, Bangladesh.
- iii. Presented Country report on “Good Agriculture Practices (GAP) Status in Bangladesh” organized by FAO RAP and BARC on 25 Sept, 2014 at BARC.
 - iv. Attended and co-chaired the “Launching and Planning Workshop of CCAFS Flagship Project (FPs) on Climate Smart Agriculture: Practices Portfolios, Institutions and Policies” organized by International Maize and Wheat Improvement Center (CIMMYT) & International Food Policy Research Institute (IFPRI) during 22-25 Feb 2014 and Indonesia during 19-23 Aug 2014 and presented project report.
 - v. Attended and presented country report on ‘Innovative National Agricultural Research and Development Programmes of Regional Significance of Food Crops, Livestock, Fishery & Natural Recourses’ in the Inter-Governmental Core Group on Agricultural Research, Extension and Farmer’s Linkages (IGCG-REF) organized by IGCG-REF, SAARC Secretariat, Kathmandu, Nepal during 24-27 June 2015.
- Besides, during the period TTMU officers attended a good number of workshops, seminars and meetings.

Linkage

TTMU maintained a strong linkage with MoA, DAE, BADC, SCA, HORTEX Foundation, KGF, FAO, CCBA etc.

Member as Technical Committees

Worked as member in the different committees viz SAARC GAP Steering Committee; SAARC GAP Certification Committee; SAARC GAP Technical Committee; Strengthening Technology Transfer Committee; Technology Transfer and Dissemination Committee.

PLANNING AND EVALUATION

PROJECT DEVELOPMENT/ PROJECT FINANCING

The Project Implementation Unit (PIU) of Bangladesh Agricultural Research Council (BARC) is

implementing the research component of National Agricultural Technology Project (NATP). This component is coordinated by Planning & Evaluation Division. A total of 108 Sponsored Public Goods Research (SPGR) sub-projects in selected identified thematic areas were being implemented at different NARS institutes and public universities of the country. Planning Evaluation Division with the assistance of the other divisions was monitoring the SPGR sub-project.

Planning and Evaluation Division of BARC has been developed a Technical Assistance Project Proposal (TPP) titled “Adaptation to Climate Change and Rehabilitation of Livelihood in South West of Bangladesh (CLAP)” for funding from German Development Corporation (GIZ) which will start very soon. A Development Project Proposal (DPP) titled *Strengthening of Bangladesh Agricultural Research Council* is preparing by Planning and Evaluation Division and revised ADP will be submitted.

PROJECT IMPLEMENTATION

To facilitate research and technology transfer, the Bangladesh Agricultural Research Council is providing research grants to various public organizations since 2004. During the fiscal year 2014-15 the Planning and Evaluation coordinated the research and technology transfer programmes of the NARS and Agricultural universities through funding of the core research and human resource development. Further, the Planning and Evaluation division organized frequent review and desk/field monitoring, for its success. With the approval of the Executive Council of BARC, an amount of Taka 140.00 lakhs was provided to the core research programmes. Findings of the completed projects implemented through different organizations are briefly described below:

Bangladesh Agricultural Research Institute

Induction of Variability and Dissemination of BARI Released Flower Varieties: Mutations are induced in different crops to create variability for further improvement. In vegetatively propagated flower plants, mutation breeding offers great potentialities as the mutated part can be conveniently perpetuated by vegetative means resulting in the development of new forms. The effects of gamma rays on flowers have been studied by several workers in abroad but no varieties have been developed through gamma radiations in Bangladesh. Hence, in the present investigation, emphasis was laid on finding out variations caused by

gamma radiations in morphological characters including colour variations. Gladiolus is highly heterozygous in its genetic constitution which makes it promising test material for inducing physical mutagenesis. Therefore, an experiment was carried out at Floriculture Farm of HRC, BARI, Gazipur during 2014-2015 to develop variety by fixing the induced variation in succeeding generations. Three gladiolus varieties [BARI Gladiolus-3 (V_1), BARI Gladiolus-4 (V_2) and BARI Gladiolus-5 (V_3)] were considered as one factor and the other factor was gamma radiation with six levels [10 Gray (R_1), 25 Gray (R_2), 40 Gray (R_3), 55 Gray (R_4), 70 Gray (R_5) and control (R_6)]. Medium sized corm of these varieties were irradiated with gamma rays at Institute of Food and Radiation Biology under Bangladesh Atomic Energy Commission, Savar and planted on November at Floriculture Farm of HRC, BARI, 2014. The experiment was laid out in RCB factorial design with 3 replications. BARI Gladiolus-3 obtained the maximum number of florets/spike (14.5), longer spike (102.5 cm) and rachis (56.0 cm) whereas BARI Gladiolus-5 obtained the heaviest flower stick (106.0g). The maximum number of florets/spike (14.8), longer spike and rachis (100.9 cm and 52.5 cm respectively) were produced by 40 Gray radiations but 25 Gray radiations obtained the heaviest flower stick (96.0g). The variety BARI Gladiolus-5 combined with 40 Gray radiations produced the heaviest flower stick (110g). The flowers those were not irradiated by the gamma rays showed poor performances in all the parameters. However, in this experiment no flower colour was changed. For creating the variability of flower colour, the experiment should be done again with higher gamma radiation doses. About 40,000 propagules/seedlings were produced on different flower crops and distributed to end users under Breeder's seed/propagule production of flower crops. Demonstration trial on gladiolus varieties (BARI Gladiolus-1, BARI Gladiolus-3, BARI Gladiolus-4 and BARI Gladiolus-5) has been set up at Gazipur, Jessore, Bogra, Rajshahi and Rangpur on late October, 2014. Four hundred fifty square meter land of a farmer were allocated for each trial for demonstration. The on-farm trial of BARI gladiolus varieties showed better performance and produced higher yield at all location. But the demand of BARI Gladiolus-3, BARI Gladiolus-4 and BARI Gladiolus-5 were more than BARI Gladiolus-1 depending on the consumer's choice, early flowering and economic profitability.

Organic Amendments in Mungbean-T.aus-T aman Cropping Pattern for Sustaining the yields and Soil Fertility in Southern Region of Bangladesh: A project work entitled "Organic Amendments in Mungbean-T.aus-T.aman Cropping Pattern for Sustaining the Yields and Soil Fertility in Southern Region of Bangladesh" has been conducted in Babugonj upazila of Barisal and Bhola sadar of Bhola districts during 2014-15 cropping season. The main objective of this project i) to increase the organic matter of soil through organic amendments in Mungbean-T.aus-T.aman cropping pattern in southern region, ii) to increase the yields and productivity of intensive cropping system through integrated nutrient management and iii) to create awareness among the farmers towards increasing the use of organic manures in intensive cropping system in southern region of Bangladesh. In each upazila, 10 farmers were selected for implemented the project work. Each demonstration consists of two treatments viz. INM (Integrated Nutrient Management) and Farmer's practice. Mungbean (cv. BARI Mung 6) was sown on 13 January to 20 January 2015. Intercultural operations were done as and when necessary. Mungbean was harvested at 70 to 81 DAE (Days after emergence). The highest seed yield 1641 kg/ha was recorded from Babugonj, Barisal from the treatment INM package. In Bhola, seed yield ranged from 1120 to 1527 t/ha. Mungbean biomass (4.02 to 8.42 t/ha) was incorporated into the experimental soil. 2nd crop T.aus (BRRI dhan 48) was transplanted at 15 June to 20 June 2015. Green mungbean biomass (7 to 9 t/ha) was incorporated into experimental plot. Seeds of 2nd crop T.aus (BRRI dhan 48) was collected from BADC, Barisal during 1st week of May 2015 and it was treated by Bavistin @ 2.5 g/kg seed. Seed bed was prepared during 10 to 15 May 2015 and sowing in seed at 20 to 25 May 2015. In respect seedling (20 to 25 days age) transplanting land preparation was done from 7 June to 10 June 2015 and fertilizers (TSP, MP, Gypsum Zinc Oxide) were applied at the same time. Seedling of BRRI dhan 48 was transplanted during 15 to 20 June 2015. First split of Urea was applied at 25 to 28 June 2015.

Adaptive Trials on newly Developed Improved Varieties of Aroids at Farmers Level: The adaptive trials were conducted with the objectives to disseminate the promising varieties of aroids at different Agro-ecological zones of Bangladesh as well as to increase the area, yield and production of aroids and to increase farmers benefit by growing promising varieties. Four varieties of panikachu namely BARI panikachu-2,

BARI panikachu-3, BARI panikachu-4 BARI and panikachu-5 and one mukhikachu variety BARI mukhikacu-2 with local varieties were considered in the trial. The farmers were selected through DAE personnel in the respective areas. Seed cormels of mukhikachu and suckers of panikachu were supplied to the farmers during the crop season. Each farmer was advised to cultivate all the supplied varieties along with local check. Now, the crops are in vegetative stage. The stolons of panikachu has been harvested for 1-2 installments, but rhizomes are remained.

Development of Fertilizer package for four crop based cropping pattern in rice based cropping system: Three field experiments with cropping patterns CP₁ = T. Aman – Mustard- Boro – T. Aus at Gazipur and Jessor, CP₂ = T. Aman – Potato – Boro –T. Aus at Bogra and Rajbari, Dinajpur and CP₃ = T. Aman – Mustard – Mungbean –T. Aus at Rajshahi and Barisal was initiated from July 2014. T. aman harvested at the end of October 2014 to grow rabi crops mustard and potato in time and impose fertilizer treatment from rabi crop (upland crops). The cropping pattern actually started from rabi crops after timely harvest of T.aman rice and fertilizer treatment was incorporated from the rabi crops (upland crops). For development of fertilizer package for four crop based cropping pattern in rice base cropping system the three cropping patterns finally shaped as follows: CP₁ = Mustard –Boro- T. Aus-T. Aman, CP₂ = Potato – Boro- T. Aus –T. Aman, CP₃ = Mustard – Mungbean –T. Aus-T. Aman. There were Eight different treatments viz. T₁ 100 NPKSZ_N (STB), T₂: T₁ + 25% N, T₃: T₁ +25% NP T₄: T₁+25% NK, T₅: T₁+25% PK, T₆: T₁ +25% NPK, T₇: 75% of T₁T₈: Native nutrient were. The experiment was laid out in RCBD design with three reflections. Data revealed that the yield of mustard (BARI) Sarisha 14), potato (Diamont) and Boro (BRRI dhan28) was significantly influenced by the fertilizer treatments. The highest yield was obtained from the T6 treatment where 25% additional NPK was added over the 100% STAB rate in all the locations. At present for all the three cropping patterns T. aus (parija) is in the field at flowering stage. After harvest of T.aus rice Boro (BINA dhan-7) will be cultivated. After harvest of T.aman rice the cropping cycle will be completed and final result will be find out.

Intensive BARI Development Vegetables and Fruits Production Programme for the Beneficiaries in Rural Area/Dissemination of BARI Developed Promising Vegetable and fruits varieties at Bogra: On-Farm trials was conducted using proposed

vegetable and fruits crops and their varieties to study the adaptability at Jorgachha union of Sonatola Upazila of Bogra district during late winter/early summer-2015 (January-February). The selected crops for this season were: red amaranth, stem amaranth, shabuj data shak, kang kong, Indian spinach and in summer season crops are included: okra, snake, gourd, ridge gourd and bitter gourd and fruit crops viz: mango, papaya, guava, banana, pummelo and jujube while, company or local variety of vegetable was used as check to make comparison. Based on the findings of base line survey selected farmers were trained in light to improve awareness and knowledge on modern vegetables and fruit production techniques (two trainings per year) while resource speaker were invited from HRC, BARI and DAE. Subsequently, inputs were supplied to conduct trials. The findings revealed that all BARI released vegetable varieties were contributed higher yield compared to control. The same varieties were also possessing higher BCR. Therefore, BARI varieties are accepted by the farmers for its better genetic potentiality and wide range of adaptability.

Propagule/Seedling production and dissemination of BARI released fruit varieties for increased quality fruit production: A study was carried out at the Pomology Division, Horticulture Research Centre. BARI, Gazipur during July 2014 to June 2015 in order to produce good quality propagules/saplings of BARI developed promising fruit varieties to the fruit growers/farmers to increase their income as well as livelihood. A base line survey at Fulbaria, Mymensingh and at Kaliakoir, Gazipur was carried out to know the initial status of the farmers regarding fruit cultivation, availability of land, high yielding variety etc. A total number of 1800 grafts of BARI released varieties of mango, litchi, guava, lemon, pummelo, sweet orange, wax jambu, sapota, longan and aonla are now ready for distribution in the two project sites; Fulbaria, Mymensingh and Kaliakori, Gazipur and those will be distributed among the selected 60 farmers for two locations (30 farmers/location) soon. Fertilizers have already been distributed among the selected farmers for applying in the pit. Moreover a total number of 2000 grafts of mango (BARI Aam- 2, 3, 4, 8), pummelo (BARI Batabilebu -3, 4) sweet orange (BARI Malta-1), golden apple (BARI Aam-1, 2), Wax Jambu (BARI Wax Jambu 1, 2), Sapota (BARI Safeda-3), aonla (BARI Amloki-1), longan (BARI Longan-2) and carambola (BARI Carambola-1) have been prepared through vegetative propagation. For seedling production of guava (BARI Peyara-2) and coconut

(Narikel-1, 2) seeds/nuts have been sown at proper time and intercultural operations are being maintained. Two trainings; one at Pomology Division, HRC, BARI, Gazipur and another one at Fulbaria, Mymensingh have been conducted. In each training programme, 30 farmers were participated.

Development of a mechanical vegetable washing machine: A study was conducted in Farm Machinery and Postharvest Process Engineering Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur. A base line survey was conducted on vegetable production, sorting, washing, packaging mainly of carrot, red amaranth and brinjal from three vegetable growing districts such as Narsinghdi, Bogra, Jessore, and one major carrot growing area Pabna for developing a mechanical vegetable washing machine. Two upazila from each district were selected considering the primary and secondary markets. The respondents for primary data collection were 71 farmers, 30 pickers and 20 retailers. Washing of vegetables mainly practiced by farmers and pickers and it varied from location to location. Sorting and grading were done either farmers or pickers. In all locations, red amaranth and root crops (carrots and radish) are washed by farmers to get better price. A vegetable washing machine was designed based on the base line information. The capacity of the machine would be 1.0-1.5 ton/h depending on the type of vegetables. The fabrication is going on and expected to complete in the next financial year (2015-16).

Impact of Hybrid Rice and Maize Seed in Cereal Production System in Bangladesh: The present study was undertaken on hybrid rice and maize seed production and marketing scenario, farmers' perception and efficiency of hybrid rice and maize producers. The goal of the project will be achieved after three years (2014-15, 2015-16 and 2016-17). In first year, data of 20 seed dealers and 200 farmers have been collected and analyzed from Dinajpur and Sherpur on hybrid rice. In addition, data of major 10 seed companies have been collected and analyzed. About 4 thousand tons of hybrid rice seed have been imported by the 10 seed companies in 2014-15 which is about 38% of total import of hybrid rice seed. All the seed companies sale their seed through distributor, seed dealers and retailers. Only BADC (HL 8 h) produce hybrid rice seed but it is not more than 10% of total import. Farmer's gross return and gross margin have been increased using hybrid rice seed compared to HYV rice seed. Gross margin was 22% higher in Dinajpur and 28% in Sherpur using hybrid rice seed over HYV seed. The

results of stochastic frontier production function (SFA) indicated that translog production function was preferred and the parameter and of the maximum likelihood estimates are significant which means that inefficiency effects are present in the analysis and the traditional "average" production function is not an adequate representation of the data. Hence, technical inefficiency effects have significant impact on output. These results suggest that there is a substantial scope for increasing hybrid rice production in the country using hybrid rice seed. Farmers are happy by producing hybrid rice as it is higher yielder. Most of the farmer's opinion is, if per kg price of rice increase, then area of hybrid rice will be increased

Development of Geodatabase for Haor Region for Sustainable Intensification of Agriculture: Monitoring land-use/cover (LUC) change and exploring its mechanisms are important processes in the environmental management of haor area. A research programme for the period of three (3) years (2014-2017) with support from BARC research grant was initiated for the development of geodatabase for Haor region for sustainable intensification of agriculture specially to develop thematic map layers of seasonal LUC dynamics, to identify fallow Kanda lands as well as to suggest suitable crop(s) for the haor for sustainable intensification using remote sensing and GIS techniques. Landsat 4/5/7/8 multi-spectral data and MODIS time series composite data product during the years 2000-2015 and other available satellite data were used in association with comprehensive ground survey to identify land use/cover, and kanda land in the Haor area. Ancillary geospatial data from other secondary sources such as topographic maps, communication networks, water level, etc. also were used to improve the accuracy of the maps. For the first year (2014-2015), we visited different haor areas including two ecologically critical Ramsar sites namely Tanguar haor and Hail-Hakaluki haor. Comprehensive ground survey was done during those visits with HandHeld Spectroradiometer and GPS to identify existing LU/LC including fallow Kanda land. Sixteen (16) days composite of Aqua and Terra MODIS images during 2000-2015 were downloaded from USGS data archives. Besides Landsat 4/5/7/8 images during 2000-2015 were downloaded from USGS archives as well. Sixteen (16) days composite of Aqua and Terra MODIS images during 2011-2012 were analyzed and found that most of the haor area had gone underwater from June to November. Then the land (e.g. Kanda) became available from December-January to April-

May. We also found that most of the land in the Haor districts was available for agriculture during Rabi seasons. Attempts to develop original geospatial maps for current agricultural land use as well as spatial and temporal availability of Kanda lands from remotely sensed data besides acquisition of existing geodatabases from repository of other public organizations will be continued in the remaining time period (2015-2017) of this study in order to develop a comprehensive geodatabase of haor region which may be used to develop a smart decision support system for sustainable intensification of agriculture and natural resources management of the area.

Information of BARI technology at farmer's doorstep through Mobile Apps: Extension services provide critical access to the knowledge and technological information that farmers require to improve their productivity. It is crucial to provide farmers with the knowledge and agro-technological information in a quality and timely way. Information and Communication Technology (ICT) can play a vital role to do this effectively and efficiently. Mobile phones have provided new opportunities for rural farmers to obtain knowledge and information about agricultural issues, problems and its usage for the development of agriculture. An Android based mobile apps named BARI application “কৃষি প্রযুক্তি ভার্ভার” was developed to make available crop production packages at the right time at stakeholder's doorstep in a cost effective way. BARI apps “কৃষি প্রযুক্তি ভার্ভার” has five options namely (i) crops, (ii) other technology, (iii) query, (iv) feedback and (v) communication. At present 400 varieties and technologies hosted in the mobile apps which included crops like oilseed crops, pulse crops, tuber crops, wheat, maize, fruits, vegetables, flower, spices crops, rice, jutes, cotton and sugarcane, etc. It also hosts other technology like postharvest technology, farm machinery, irrigation and water management, insect & pest management, etc. Any stakeholder can ask/inquire about related technology through query option. Answers of the queries are also stored in the feedback option. Related specialists' names and addresses with mobile number are hosted in the apps. So stakeholder can directly contact with related specialists through communication option. Mobile apps “কৃষি প্রযুক্তি ভার্ভার” is regularly updated with maintenance and newly developed technologies are added. This apps can be downloaded from Google play store and then be used through Android based mobile offline. The apps can also be shared with other android based smart phones using SHAREit apps even without

internet. The total contents of this app is in Bangla language. Besides other stakeholders, farmers can use these apps easily and effectively for crop production and thus Information of modern crop production technology could be reached at the farmers' doorstep through this Mobile Apps.

Collection, Conservation, Characterization and Evaluation of Underutilized Fruits in Chittagong Hill Tracts:

A approved project Collection, conservation, characterization and evaluation of underutilized fruits in Chittagong Hill Tracts under Research Grant of BARC was conducted at the Hill Agricultural Research Station, Raikhali, Rangamati Hill district during 2014-15 with the objective of collect, conserve, evaluate and characterization of endangered minor fruits in Chittagong Hill Tracts. For the first year it partly completed a survey work in Rangamati and Bandarban Hill Districts and collected total sixty seven germplasm of six minor fruits like pummel, mandarin, bael, rokto gola, aingchi gola and peach. Characterization of aonla, exotic date palm, peach, cherry, dragon fruits and cultural management works are also going on in the existing established minor fruits orchard of HARS, Raikhali, Kaptai, Rangamati Hill District.

Development of Population for Gynodioecious Papaya Variety:

The study to develop gynodioecious population for developing papaya variety containing 100% productive plant and to increase farm income through papaya cultivation was carried out at the Fruit Research Farm of Pomology Division, HRC, BARI, Gazipur during the period from December 2013 to November 2014. Seedling of S₁ and F₁ progeny were planted in the main field on 07 March 2014. Total 438 seedlings of S₁ progeny were planted and it was observed, 275 andromonoecious plants and 163 female plants but no male plant was noticed in the population. On the other hand, in 51 plants of F₁ (Shahi X CP Joy-005) population, it was found 31 andromonoecious and 20 female plants without any male plants. Number of fruits per plant was found 20 and 18 in S₁ and F₁ progeny, respectively. The flesh colour of S₁ fruits was noticed bright yellow but it was found very light pink colour in F₁ fruits. The shape of S₁ and F₁ progeny was found elongated and oval, respectively. The TSS (%) of the fruits was found 10.50 in S₁ progeny and 9.30 in F₁ progeny. Seeds of S₂ and BC₁ progeny have been sown in the seed bed on December 2014. Evaluation of S₂ and BC₁ progeny along with new germplasm will be continued.

Bangladesh Rice Research Institute

Evaluation of advance breeding lines for the development of heat tolerant rice: An experiment was conducted to evaluate the breeding lines of rice to develop a high temperature tolerant rice variety. Besides this some rice germplasm were screened out to identify high temperature tolerant genotype which can be used as donor parent. Ten breeding lines (BCIF2) and 110 genotypes were evaluated. Twenty days seedlings were transplanted in earthen pots which were filled with soil. The experiment was conducted in randomized completely block design. The plants were fertilized and intercultural operations were done when necessary. There were 3 hills per pot and 6 pots were maintained for each genotype. All pots were placed in natural condition until heading with BRRI recommended management practices. During heading the pots were placed at high temperature ($35\pm 3^{\circ}\text{C}$) and high humidity ($75\pm 5\%$) in controlled glass house for seven days. After that the pots were moved to natural condition. At harvest floret fertility and physiological traits for the plants were examined. Among the breeding line nine entries showed 38 to 50% fertility under heat stress treatment and got SES score 5. These lines will be grown in the field to examine yield and phenotypic characteristics. The promising lines selected from the field will be further evaluated for high temperature tolerant.

Bangladesh Jute Research Institute

Development and popularization of value added jute-based diversified blended product: Bangladesh is the largest producer of jute fiber in the world. But now-a-days jute is facing tough competition with synthetic fibers. For the survival of jute, it is necessary to diversify the uses of jute and developed new products by blending jute with cotton and native sheep wool. It is now common practice to blend two or more fibers together in order to produce yarns of fabrics with required properties. Blending of jute with other fibers (Such as cotton, native sheep wool, silk, viscose Rayon, Jute-cell, wood-cell etc.) may be considered as an alternative and possible diversified uses of jute yarns and fabrics. Jute fiber can be blended with cotton, native sheep wool and blended fabrics could be used as shirting, suiting terry towel and for other upholstery purposes. Because of its great abundance and shortage of cotton, jute is blended with cotton and jute cotton-blended yarns are manufactured mainly to take advantages of the lower price of jute fiber. Jute is blended with cotton and natural fiber and the blended

yarns are used for production of blended value added fabrics. For this reason quality jute-cotton and native sheep wool blended yarn is required. To produce value added diversified product. Hence, jute cotton blended value added products viz. sample of shirting and suiting has produced under this core programme.

Soil Resource Development Institute

Introduction of Quesungual Slash and Mulch Agroforestry System (QSMAS)- an eco-efficient method of enhancing crop yields and soil quality in Chittagong Hill Tracts: The Chittagong Hill Tracts region is of great importance for growing various crops, which are different from the plains. Farmers practice traditional Jhum culture for their livelihood. They slash and burn the vegetation on hills and go for Jhum cultivation which contributes to soil and nutrient loss. It can also lead to land degradation if population pressure reduces the fallow periods needed for the recovery of natural resources. A Questionnaire based survey in six Upazilas of Bandarban revealed that the hill dwellers are lagging behind in education, farming knowledge, access to information on modern culture, inputs and loan facilities. As such they could seldom produce enough food for their consumption. The Quesugual Slash and Mulch Agro-forestry System (QSMAS) is a smallholder production system with a group of techniques for the sustainable management of vegetation, soil and water resources in drought-prone hillsides. The system was developed in the early 1990s in close collaboration with farmers and technicians from FAO and other institutions, as an alternative to traditional and widespread slash and burn agriculture. The present research work was undertaken to introduce an eco-friendly productive crop production system in sloping lands of CHT which will mitigate the process of land degradation due to Jhum culture as well as take care of food security of Hill people.

Cotton Development Board

Bioefficacy Evaluation of Different Botanical Extract against Cotton Sucking Insects: Cotton is one of the most important fibre crop of our country. Studies were made to evaluate the effectiveness of some botanical extracts against cotton sucking insect i.e. aphid and jassid at four (4) research centers of Cotton Development Board located at Sreepur, Sadarpur, Jagadishpur and Mahigonj. The experiment consisted of eight treatments were allocated in the field following randomized complete block design with 3 replications. The incidence of sucking pests were

recorded once in a week from 10 randomly plants at each plot. Spraying was done when the pest population crossed the ETL level. Significant differences were found in the relative efficacy of different treatments in reducing the jassid population and their persistence at different days after treatment (DAT). The extract of Mehogony was found the best in controlling jassid., achieving 60% mortality at 3 days after spraying. Plant extracts are biopesticides having less or no hazardous effects on human health and environment. Thus they can be incorporated in IPM programmes in cotton cultivation.

Bangladesh Tea Research Institute

Studies and Development of IPM strategies for plant parasitic nematodes in tea: A series of experiment were carried out in different tea estates of six valley circles in greater Sylhet region to identify different plant parasitic nematode genera associated with tea seedlings, their seasonal abundance and distributional pattern in different valley circles as well as to determine crop loss due to plant parasitic nematodes. Soil samples were collected from rhizosphere of tea seedlings of secondary nursery using a soil sampling auger at a depth of 0-9". Baermann funnel technique with some modifications was followed to extract nematodes from the soil samples. Plant parasitic nematodes were identified up to genus level based on morphological characters and measurement. A total of seven plant parasitic nematodes genera belonging to six families associated with rhizosphere soils of tea seedling were identified from seventeen tea estates of six valley circles. The identified nematode genera were *Helicotylenchus*, *Hoplolainus*, *Partylenchus*, *Tylenchus*, *Aphelenchoides*, *Siphinema* and *Dolichodorus*. The genera of plant parasitic nematodes viz. *Helicotylenchus*, *Hoplolainus*, *Partylenchus*, *Tylenchus*, *Aphelenchoides* were reported earlier from Bangladesh tea. *Xiphinema* and *Dolichodorus* are the first time recorded from tea seedlings in Bangladesh. The highest nematode genera were found in the tea estates of Balisera valley circle where as only one nematode genus was found in juri valley circle. During winter period nematode population was low in all the valley circles. The highest average nematode population (12.33) was found in the tea estates of Balisera valley circle followed by that of Lushkerpore (10.13) and Lungla (9.15) valley circle. The lowest average nematode population (5.10) was found in the tea estates of juri valley circle.

Bangladesh Agricultural University

Improved detection, monitoring and management of two major beetle pests in stored grain through use of a multispecies lure and reduced risk insecticide: Research has focused on improving trapping technology by the discovery of low cost additional pheromones, incorporation of food odor synergists, slow-release formulations, and also improving trap design for *Tribolium castaneum* and *Callosobruchus chinensis* the two major storage pest. Mixture of volatiles obtained from carob, rice bran oil, poultry feed and yeast were evaluated. Two beetle species were detected by the trap where 54% *C. chinensis* and 42% *T. castaneum* were caught in 72 hours after release. Lure based on food attractants showed the potentiality to attract more than one species and therefore, has an advantage over pheromone-based lures when the problem with multiple species exists. Efficacy of the biopesticides Neem, Kranja and Spinosad against pulse beetle was assessed using filter paper dip method. Results revealed that Spinosad (Tracer 240 SC) was the most effective against the target pest providing with the maximum mortality of 55% at 2.5% dose in 168 h exposure time and the minimum of 17% at the concentration of 0.5% at 24 h exposure time. This finding demonstrated the potential of spinosad as a biopesticide in the control of pulse beetle. Small scale on-farm validation of the developed technologies is in progress at the storage of progressive farmers' in Mymensingh region. Two MS theses in this area of research are on progress and expected to be submitted by June 2016.

Collection and Molecular Characterization of Brinjal and Mango Plant Genetic Resources- Two Important Geographical Indication (GI) Crops of Bangladesh: The objectives of the present study were to collect and characterize the collected/selected plant genetic resources of mango and brinjal; two important GI crops of Bangladesh using morphological and molecular techniques at the Department of Horticulture, Bangladesh Agricultural University (BAU), Mymensingh. During the reporting period, 19 accessions of brinjal mainly from greater Mymensingh district have been collected and their morphological characterization along with field performance during the summer season has been reported. Along with that, molecular characterization of the 19 collected accessions of brinjal using RAPD and SSR markers is in progress. The experiments are going on and the final conclusions will be made after getting the results of the

experiments. Also morphological characterizations of 35 collected mongo germplasm in ex situ at Horticulture Farm, BAU and 60 selected mango accessions at Chapai Nawabganj were performed using IPGRI descriptors. Along with that research works on molecular characterization of the above mango 25 and 60 mango germplasm, respectively using RAPD and SSR markers are in progress.

Development of sustainable technologies for improving nutrient and water use efficiency in rice production: Two pot experiments were conducted to determine the response of ten rice cultivars to different water management systems and nitrogen application. The rice cultivars BRRI dhan28, BRRI dhan29, BRRI dhan47, BRRI dhan50, BRRI dhan59, BRRI dhan60, BRRI dhan61, BINA Dhan8, BINA dhan10, BINA dhan14 developed by BRRI and BINA were grown maintaining five irrigation treatments (T_1 - Continuous saturation T_2 - Alternate flooding and wetting at 4 days after disappearance to 4 cm water, T_3 - Alternate flooding and wetting at 6 days after disappearance to 4 cm water, T_4 - Alternate flooding and wetting at 8 days after disappearance to 4 cm water, T_5 - Alternate flooding and wetting at 10 days after disappearance to 4 cm water). The same varieties were grown in another pot experiment maintaining four nitrogen level- N_1 - 0 mg kg⁻¹ soil + PKSZn (Recommended), N_2 - 75 mg kg⁻¹ soil (Lower than recommended) + P K S Zn (Recommended), N_3 - 150 mg kg⁻¹ soil (Recommended) + PKSZn (Recommended), N_4 - 225 mg kg⁻¹ soil (Higher than recommended) +PKSZn (Recommended). The treatments were arranged in a Completely Randomized Design (CRD). Variety and water management systems showed significant effect on the growth, physiological, yield and yield contributing characters of different rice cultivars. The highest grain yield (26.19 g pot⁻¹) was obtained in Binadhan-10 In respect of water management systems, alternate flooding and wetting at 8 days after disappearance of 4 cm water (T_4) produced maximum grain yield (22.96 g pot⁻¹). It was also found that the crop grown continuous saturation (T_1) treatments respectively did not increase the yield, rather caused the wastage of irrigation water. The water use efficiency (WUE) was the highest (0.252 tha⁻¹cm⁻¹) in treatment I_5 , obviously due to minimum water use but highest yield was observed in I_4 because of optimum use of water and non stress condition. Nitrogen application @ recommended dose produced maximum grain yield (24.13 g pot⁻¹).

Production of algae to use as environment friendly feed supplements for poultry: Aquatic algae (*Spirulina platensis*) contains higher amount of micronutrient like protein, carotenoids and other micronutrients. It may be grown in different organic media (eg, agro-industrial wastes such as sugar mill waste effluent, poultry industry waste, fertilizer factory waste and organic matter) or inorganic medium (N, P, K, Mg, S, Fe, Ca, Zn, Cu, and Mn). It has high growth potential and abundantly growing throughout the world. It assimilates CO₂ and emits O₂ during photosynthesis in the presence of light. So, algae would have potential use in poultry feed to increase production and improvement of product quality after growing in artificial media. Considering the point Spirulina was cultured in inorganic media (Kosaric media) Contained different macronutrient like NaHCO₃, K₂HPO₄, NaNO₃, K₂SO₄, NaCl, MgSO₄.7H₂O, CaCl₂, and FeSO₄. 2H₂O as well as micronutrient H₃BO₄, MnCl₂.4H₂O, ZnSO₄.7H₂O, CuSO₄.5H₂O, MoO₃, CoCl₂.6H₂O. Media was autoclaved and Spirulina was cultured for 12 hours lighting and fiving continuous aeration for 15 days to use in poultry feed along with culture. One hundred and forty four day old broiler chicks were reared offering starter mash diet for 7 days. Afterwards birds were divided into 6 groups having 24 birds in each (8 per cage). Birds were offered 1. Control diet, 2. 75% Vit-Min+25% Spirulina 3. 50% Vit-Min+50% Spirulina 4. 25% Vit-Min+75% Spirulina, 5. 0% Vit-Min+100% Spirulina and 6. 0% Vit-Min+0% Spirulina (negative control). Spirulina was calculated on DM basis added minerals in the media. After 21 days (28 day old) final body weight was 1001, 1070, 1044, 1065, 1163 and 871 g/bird in group 1, 2, 3, 4, 5 and 6 where significantly (0<0.5) higher weight observed in Spirulina group (5) but lower in negative control (6) and control group (1). But feed intake observed more of less similar in all the groups (1483±24 g; p>0.5), Feed conversion ratio (kg FI/kg LWG) observed significantly different like 1.79, 1.62, 1.67, 1.61, 1.51 and 2.06 in group 1, 2, 3, 4, 5, and 6 respectively. Where significantly (p<0.5) higher in negative control group (6) and control group (1), but was lowest in highest Spirulina group (5). Considering growth performance of broiler complete replacement of vitamin mineral premix would be possible by Spirulina culture in broiler diet. Further research is needed for confirmation economic and feasibility to recommend in diets of different poultry species.

Study of reproductive endocrinology of mud eel *Monopterus cuchia* for artificial propagation: Fry production in captivity and introduction to aquaculture are useful tools for conservation of any threatened fish species like Mud Eel (*Monopterus cuchia*; locally ‘cuchia’). Therefore, the current project is aimed at domestication, captive maturation and fry production trial of cuchia through induced spawning. Information on reproductive biology, food, feeding, behavior, etc of cuchia has been revealed through research on this species during first three years of this project. This year, the main objective was to trial fry production through induced spawning. After domestication of wild broods in captivity, key informant survey was conducted in some selected areas of Mymensingh region where *adibashi* communities are involved with harvesting cuchia from nature. This interview revealed information on behavior, feeding and breeding of cuchia in the wild. For ‘natural breeding’, earthen breeding pits of 7 m² were constructed. Pit bottom was covered by polyethylene sheet followed by a 15-cm layer of mud over the sheet. The pit was allowed to be covered by a thick layer of aquatic weeds. Breeder fish at different densities and different male-female ratios were stocked in the breeding pit. A stocking size of 20 fishes (10 male, 10 female) per breeding pit gave the best result in producing cuchia spawn. Both rubber and PVC pipes were laid down on the bottom mud to provide shelter and create breeding hole for cuchia. Some PVC pipes were poured inside the mud to provide the same. Water depth was maintained in a way that it does not exceed 0.4 meter. In Late April, broods laid eggs and some of the eggs were collected from breeding holes inside the pits and in the Mid May, cuchia fry were found inside the breeding holes and in breeding pits. Cuchia fry are now being reared in plastic bowl with gentle water flow and aeration. Different natural and artificial starter feedstuff are now being offered to identify the first fish of this fish in captivity.

Resistant breeding for salinity stress tolerance in Rice: Marker assisted screening is very effective and reliable to identify several traits associated with abiotic like salinity. In total twenty two (22) rice genotypes including advanced lines and modern varieties were used to carry out this research for screening salinity tolerant genotypes by morphological and molecular analysis. Salinity screening was performed at seedling and reproductive stages using modified hydroponic method and sustained water bath following IRRI standard protocol respectively. For the phenotypic

study of 22 rice genotypes, saline water having EC 6dsm-1 was used at seedling stage. At reproductive stage, saline water having EC odSm-1, 8dSm-1, 10dSm-1 and 12dSm-1 were used. Based on SES standard scoring , Binadhan 8, RC 221, RC 225, RC 191, Binadhan10, FL-478 genotypes were found to be tolerant at seedling stage. After different phenotypic study at reproductive stage, variety Binadhan8, Binadhan10, Pajam, BRRI dhan39, RC 225, FL-478 were found to be tolerant while RC 192, Cherangi, Binadhan7 were found to be susceptible. Rest of the genotypes RC 217, RC 225, RC 227, RC 193, BRRI dhan29, RC 249 and RC 222 were found to be moderately tolerant. All the tolerant genotypes performed best at nonsaline condition and lowest performance was observed at 12dSm-1 salinity stress. Rice genotypes showed wide variations in salinity tolerance phenotypically at both stages. For molecular study of rice germplasms, DNA was extracted from young leaf samples using IRRI standard method. In this study three (3) selected SSR markers viz. RM32, RM80 and RM1287 were used to screen the genotypes for salt tolerance. Banding pattern of rice lines against three SSR markers identified RC 191, RC 192, RC 225, RC 271. Binadhan8 and Binadhan10 as salt tolerant genotypes. From the SSR analysis, it was found that an average number of 8 alleles per locus were detected with PIC values ranged from 0.7067 (RM32) to 0.8309 (RM1287). The highest gene diversity (0.8471) was observed in loci RM1287 and the lowest gene diversity (0.7479) was observed in loci RM32 with a mean diversity of 0.8085. These screening results could be used for further selection and development of improved salt tolerant varieties, as salinity stress is a great challenge for plant breeders.

Bangabandhu Sheikh Mujibur Rahman Agricultural University

Development of short duration high yielding aromatic rice variety suitable for three growing seasons of Bangladesh: This research was done to determine yield performance of new aromatic rice over the three growing seasons of the year. The new rice (BU-9958-40-1) was development through hybridization between Indian Basmati and IR5802B. The advanced line possesses characteristics of earliness, aroma and high zinc and iron content. This line was evaluated against three varieties during three consecutive seasons of 2014-15 at seven locations of the country. The check varieties for the experiment were BUdhan 1, BRRI dhan50 and BRRI dhan65 for Aman, Boro and Aus season, respectively. The

experimental locations were spread at BSMRAU, Kapasia, Rangpur, Chandanda, Ishurdi, Faridpur and Chittagong. Results of Aman and Boro seasons are available while Aus crop is at harvesting stage. Results of Aman season revealed that the new rice performed better at BSMRAU, Kapasia and Rangpur with an average yield of 4.26 t ha⁻¹ in comparison to average yield (4.97 t ha⁻¹) of Budhan 1 as check variety. Similarly in Boro season, the new rice exceeded the yield of check variety BRRI dhan50 in most of the locations with an average yield of 5.84 t ha⁻¹. Considering higher yield, earliness, among along with high zinc and iron content, this advanced line of rice is expected to release as a new rice variety suitable for growing three seasons of the country.

Yield gap minimization of boro rice in the haor areas through agronomic management with special reference to fertilization: The project was implemented in the representative of the deeply flooded low lying area of haor (Dekar haor) at the village Bahadurpur under union Lakshanshi of Sadar upazila of Sunamganj district. The project was aimed to minimize the yield gap of boro rice in the haor area under Sunamganj district and piloting the developed technology package for further dissemination. Three experiments were conducted in the first year programme to fulfill the objectives. The first experiment was the yield gap minimization of two varieties boro rice with the proper use of fertilizers to see the varietal performance and fertilizer effect on growth and yield of boro rice. Two varieties (BRRI dhan29 and BRRI dhan58) and three fertilizer treatments (Farmers' practice, Fertilization based on BARC recommendation guide and Soil test based fertilization) were included in the experiment. BRRI dhan58 showed the better performance in respect to growth and yield with fertilizer doses of BARC recommendation guide. The 2nd experiment was entitled 'effect of fertilizer and irrigation methods on the yield gap minimization of boro rice' to see the effect of fertilizer and irrigation methods on growth and yield of boro rice. Two fertilizers doses (Farmers practice and Fertilization based on BARC recommendation guide) and three irrigation treatments (Farmers practice, Dry and Wet method of irrigation, and Wet irrigation method) were included in the experiment. The grain yield obtained 7.70 t ha⁻¹ in the farmers' plots and 8.54 t ha⁻¹ due to fertilizer balance application. The highest yield of 8.36 t ha⁻¹ was obtained due to wet irrigation system. The title of 3rd experiment was the 'effect of fertilizer and agronomic

practices on the yield gap minimization of boro rice'. The experiment was conducted in five farmers' fields with two fertilizer doses (Farmers practice and Fertilization based on BARC recommendation guide) and three fertilizer treatments (Farmers practice, Proper seedling age and spacing; and Proper seedling age and spacing + Integrated Pest Management). BRRI dhan58 gave the higher yield with application of balance fertilizers.

Development of artificial breeding techniques of Sperata aor: Bangladesh is blessed with a rich fish biodiversity and is ranked third in inland fisheries in Asia after China and India with approximately 300 fresh and brackish water fish species (Hussain and Mazid, 2001). Fish and fisheries play important roles in the economy of Bangladesh. Once upon a time, the country was enriched in various indigenous fish species. But now these species are declining day by day due to various anthropogenic reasons. Ayre (*Sperata aor*) commonly named as long-whiskered catfish is one of the important bagrid catfish. It has been considered as one of the most admired edible fish among indigenous catfish species due to good taste and high nutritive value. This fish species has a very good market demand. But unfortunately natural stocks of this species have drastically reduced and become threatened due to overfishing, habitat degradation, aquatic pollution, and several other anthropological reasons. Presently, *S. aor* is regarded as vulnerable (IUCN-Bangladesh 2000) fish species. In order to maintain this fish population as well as to conserve their biodiversity in nature immediate measures should be taken. So, the overall goal of this project was to carry out a detailed and in-depth scientific study in order to establish artificial breeding techniques of *S. aor*. To achieve this goal it is necessary to understand the breeding biology of this species, assess their reproductive potential in captive condition as prerequisites. A number of brood fish were collected and reared in the research ponds both on station (Research ponds in the Sylhet Agricultural University campus) and on farm (American fish farm Ltd. at Zakigonj) for nine months periods. Their growth performances were measured on month basis. To examine the monthly changes in the gonads for estimating spawning season, the GSI was calculated by: GSI = (Weight of gonads/weight of fish)X100. The average length and weight of the *S. aor* fry became 27 cm and 148 gm, respectively on station in April. While on the farm it became 39 cm and 700 g, respectively. On the other hand, average length and weight of the brood became 34 cm and 500 g,

respectively on station. While on the farm it was 45 cm and 1000 gm, respectively. The brood fishes reared in on station ponds did not perform natural breeding yet. But on the other hand, natural breeding of *S.aor* was observed in on farm in captivity. The GSI of female was found to be decreasing from October to February and lowest was recorded on December. It was found to be increasing from February to May. On the other hand, the lowest GSI (Gonado-somatic Index) value of male was found in November and after that it was gradually increasing and the highest was observed in May.

Patuakhali Science and Technology University

Increasing fertilizer and irrigation water use efficiency for crop production in southern coastal saline soils of Bangladesh: Soil and water salinity is the number one constraint for crop production in coastal region of Bangladesh. Appropriate technology is needed for management of saline soils which can ensure limited use of irrigation water. The project is therefore undertaken to develop polythene mulch technology for introduction of maize and sunflower crop in the coastal region which will successfully reduce the evaporation loss of water from soil. Seven experiments were undertaken during January to June 2015. More than 80% germination of both maize and sunflower was recorded within 4 dS/m salinity, beyond this germination falls rapidly. From pot experiment it was found that use of polythene mulch in saline soil gave comparable yield as in non saline soil. Deep tube-well water salinity level was much higher than the standard limit. River and pond water salinity increases with passes of time from January and reaches at peak in April to May. From the field experiment polythene mulch technology was found very good technology for cultivation of maize and sunflower in coastal saline soils as it potentially reduce the evaporation loss of moisture form soil. In polythene mulch treatment EC value was less than 4 whereas in without polythene mulch treatments it was above 10. The maize and sunflower yield was at least double in polythene mulch treatment than without polythene mulch treatment. Polythene mulch technology is recommended for much popularization in the coastal saline regions of Bangladesh.

Monitoring of Programmes/Activities

Nine teams were formed with the scientists of BARC for field monitoring of the research/technologies transfer programs carried out during the period of

2014-15. The teams were assigned to visit and monitor the BARC funded research/technologies transfer programmes implemented by different NARS and associate institutes. But inconvenient situation field monitoring of the research/technologies transfer programs in 2014-15 was not possible.

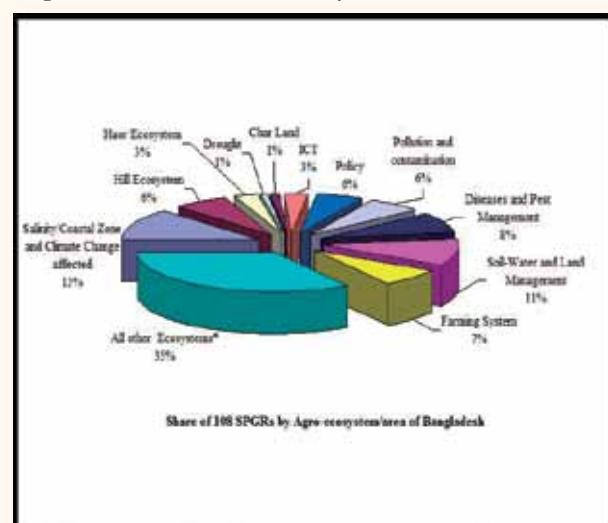
NATIONAL AGRICULTURAL TECHNOLOGY PROJECT

PROJECT DEVELOPMENT AND FINANCING

During the year 2014-15, PIU-BARC implement rest of six months July-December 2014 of NATP-1 and then PIU-BARC start NATP-2 (preparation facility) for nine month from January-September 2015. BARC part of NATP-1 was funded by GoB, Wold Bank and IFAD. Preparation phase of NATP-2 was funded by GoB.

PROJECT IMPLEMENTATION

Based on the research priorities, developed through a rigorous bottom-up process involving all stakeholders, the PIU-BARC, offered in six spells, through February 2010 to October 2012, a total of 108 SPGR sub-projects; which are basic and strategic in nature. The awarded SPGRs were implemented under 12 ecosystems/area as below:



Share of 108 SPGRs by Agro-ecosystem/area of Bangladesh

Depending on the nature of research, mostly the activities were performed in research managed plots. Based on the type of research and the level of work advancement, in some cases there were adaptive/validation activities at the farmers field as

well. In certain cases, a number of the SPGRs were implemented since inception or at the mid-point in a participatory mode by involving the farmers. As the start time of SPGRs varied obviously, thus the closure as well. However, all sub-projects have been completed.

As a capacity building, 29 Ph. D abroad and 60 local Ph. D fellows will be expected to join the scientific pool of the NARS by the end of the NATP: Phase-1. Besides, as a matter of elevating productivity, based on the findings of the long term HRD plan-the skill gap areas identified were; procurement, financial management, monitoring and evaluation, project development, research management and administration etc. Against the target of 4,216 persons, a total of 5,070 scientists, extension workers, technicians and farmers were trained in the country. A number of 9,508 persons attended local seminar/workshop while 371 scientists participated in short term trainings/seminar/workshop/study visits abroad. A total of 71 fellows have earned Ph.D and the rest are expected to be completed very soon. 10 Post-Doctoral fellowships were completed. Once these scientists complete their higher studies and join the pool of the NARS, it would create a great drive and assist to address emerging and priority issues in the coming days.

Policy Level Contribution

In this reporting, PIU-BARC hired one Nation short term and one International short term consultant. Mr. Saifur Rahman, National short term consultant on Rational Studies: Institute Reform of Financial Management worked on uniform financial management and financial code of NARS institutes and provides a report. Another consultant Dr. Beatriz P. del Rosario, International Consultant on Rational Studies: Institute Reform (Research Management) worked on rational research management and gives her report. These two reports will be created great motion in NARS.

Management and Coordination

PIU-BARC maintains the full phase management coordination with BARC, PCU-NATP, MoA, and World Bank. In research management, Director and his representative coordinate the all PI of SPGR sub-projects.

Financial Management

- **NATP-1**
 - ADP allocation for the year 2014-15 Tk. 992.00 lakh (GoB Tk.55.00 and RPA Tk.937.00). Total expenditure during the FY 2014-15 was Tk. 986.04 (GoB Tk. 49.61 + RPA 936.44 lakh)
 - Total cumulative expenditure since inception up to 31 December 2014 was Tk.16156.75 lakh (GoB Tk. 849.50 + RPA Tk. 15307.26 lakh) against Tk 172.03 lakh.
- **NATP-2 (*Preparation Facility*)**
 - ADP allocation for the year 2014-15 GoB tk 18.00 lakh. Expenditure 16.02 lakh

Major Research Achievement and Technology Generated under NATP-1 Promising Technologies Developed

Under the NATP-1 total of 42 technologies had matured and its transfer to farmers level. Further, some 14 technologies are in the process of development in future. Commendable outputs/outcome achieved from the SPGR research sub-projects include technologies on new variety, equipment and management process. The development of eco-friendly sex pheromone based pest management of major vegetable crops like okra, cucumber, cabbage, brinjal etc, contaminants and adulterants in food chain, aromatic rice variety, hybrid summer tomato and onion seed production technology, high yielding salt tolerant rice variety, multi storied and gher agro-forestry, appropriate and profitable farming practices for different agroecological zones, soil fertility and fertilizer management under varied cropping pattern and environment, surveillance of important infectious, zoonotic and emerging diseases of livestock, protocol on jute-cotton blending for apparel manufacture in cotton processing system, development of broiler sire and dam more adaptable to local environment, pure seed bull for higher dairy production, vaccine development for PPR diseases of goat, characterization of important plant genetic resources for IPR, solar pump for high value cropping, adjustable and easy to operate USG applicator, prototype on farm level potato storage, herd of improved Black Bengal goat, holistic agriculture for the haor, water productivity in the hill ecosystems, process development on the

utilization of sugar mills effluent water for irrigation, genetic enhancement of rice and sugarcane, fish breeding production and disease management, development of short stature heat tolerant wheat varieties etc. Further, cross cutting priority issues/areas of work are water management and crop disease behaviour under changed climate, GIS based land suitability, transfer of knowledge by developing rice knowledge Bank and MIS/ICT etc.

In addition some very useful information have been generated as well like, tissue culture and biotechnological intervention in molecular characterization, pyramiding drought and submergence tolerant genes in rice, varietal screening of sugarcane etc. These will act as an input for further research in the coming days leading to the development of new technologies. Besides, research on the impact of research developed varieties of pulses and oilseeds, FSR impact, consequences of tobacco cultivation and its alternate for farm level replacement etc. would be useful for future program and policy intervention. In the coming days, further work needs to be done in respect of validations and packaging of these technologies before release for wider use. Some of the developed technologies are briefly elaborated as under:

Varietal Development

Major breakthrough for expansion of cultivated area in the coastal belt is the development and release of a salt tolerant high yielding variety of rice named BINAdhan-10. This variety can withstand upto 12 dS/m with high productivity of 5-6 t/ha will contribute towards elevating rice production in about 2.85 mha of the coastal ecosystem. Seed multiplication program undertaken for the last two years involving farmers and it's a continuous process. Further, two improved varieties of aromatic rice, one high-yielding heat tolerant wheat and one hybrid summer tomato have been developed to meet the long standing need of the farmers. The yield of hybrid summer tomato is 1.84 kg/plant.

Water Productivity and Cropping in the Hill

Significant achievements made to improve and intensify crop production in the hill ecosystem, through selection of suitable crops and management techniques and major intervention in

the improvement of irrigation technology by structural and non-structural measures. Technology has been developed for conservation of water resources and to intensify the agricultural activities during dry season. Development and adoption of solar pump irrigation for high value cropping under ecofriendly environment is worth mentioning. The technology has been borrowed by the FAO and JICA and under replication in other hill areas with substantial investment.

Success Towards Mechanization

A prototype on low cost storage of potato at the farmer's level has been developed where potato can be stored for 6-7 months with minimal spoilage. The fabrications of low-cost power tiller; adjustable, light and low cost USG applicator, modified and easy to operate rice transplanter , solar pump for irrigation of high value crops are some of the outputs of SPGR research sub-projects to facilitate cultural and management practices, save labour and to augment crop production.

Lac and Hydroponic Culture for Additional Income and Employment

Lac villages have been established and more than 10000 host plants (Ber, Khair, Karoi and others) at farmers homestead have been brought under Lac cultivation. In addition, 3 mother orchards at Joydebpur, Rajshahi and Pirojpur have been established involving the farmers. The technology on the high value vegetable cultivation by hydroponics system has attracted BRAC to sign MoU with BARI for commercial purpose as well to multiply it among their beneficiaries.

Jute-Cotton Blending for Fabric Production and Enhance Diversified Use

A protocol has been developed on the use of jute fiber with cotton in cotton processing system and production of different types of fabric namely, denim, heavy twill and fine fabric which are comparable to 100% cotton fabric. By now, MoU has been signed with two textile entrepreneurs. This developed technology would reduce the dependency of the country on cotton import in the textile sector.

Technology for the Livestock Sector

To arrest the ever increasing degeneration of the economically important Black Bengal Goat (BBG), technology on the production and sustainability of the purity of the BBG has been developed and a pure herd maintained. Technology for genetically improved seed bull for enhanced production of dairy has been generated and being maintained through community approach. Two quick growing broiler strains have been developed, which are comparable to the imported high yielding ones and now have been transferred to the poultry growers.

Technology for the Fisheries Sector

Significant success attained genetic characterization of Indian Major Carps (catla, ruhu and mrigal) and induced breeding of threatened species like, bagair, mohashol and baim. Cryopreservation technique for sperm of these species have been standardized and followed. Success in baim and near-success in bagair and mohashol induced breeding has positive effect on the future intervention and research program undertaking. Through community approach, many of the evolved technologies have been validated at different ecosystem and transferred to the fishers. Technique evolved in the bio-remedification of the lake water and aquatic resources as well.

Technology for the Forestry Sector

Nursery technique in expansion, rejuvenation and maintenance of the mangrove ecosystem, community based multi layered agroforestry for higher productivity and income, stabilization and planting technique in the newly accreted char lands, intensification of land use in the shrimp farming areas of the southern coastal belt, utilization of the fallow land and homestead for production of medicinal plants for higher income and employment of the 'adibashis' in the hills are a few to mention.

Technology Dissemination and Transfer

The major output of the sub-projects have been/are being transferred to the users as many of the activities are executed through participatory approach involving the users since beginning. Notable among these are, salt tolerant rice variety for vulnerable coastal zone, IPM technology for safe vegetable production, lac for additional income and import reduction, soil-water

management under stress environment, Black Bengal Goat, pure seed bull, USG applicator etc. contributed towards elevating productivity, mitigating loss due to pest and diseases, reducing ill-management, negative climatic effect and others. The independent evaluation of the firm engaged for the purpose by PCU and the responses of the adopting/involved farmers have been reported to be highly positive. The steps like adaptation and validation trials; participatory approach; users group formation; print and electronic media coverage; publication of technical bulletins, booklets, leaflets etc. and distribution; journal article; users' training and workshop; exchange visits; and formal approach in technology transfer have been applied towards dissemination of the technologies.

Monitoring, Reviewing and Evaluation

PIU-BARC successfully completed to review and evaluate all SPGR sub-project completion reports.

Other Achievements

- Special Study in the area of Institutional Reform and Research & Financial Management
- PIU-BARC supplied special Lab. Equipment in the 8 NARS institutes
- Repair and renovation of different building of BARC
- Complete a modern vertical extension of Training building, BARC
- Complete a Digital Display Centre in BARC

National and International Linkages

Much effort is on to develop joint program with CGIAR institutions, like IRRI, ICRISAT, World Fish Centre and others.

Publication under SPGR

As a part of the awareness building and dissemination of the research innovations, besides trainings to the extension workers and farmers, 93 electronic and 62 print media coverage have been done so far. Quite a large number of TV Channels telecasted the generated technologies and success stories of SPGR sub-projects. On the other hand, 60 journal articles published by the researchers both in local and foreign journals and 66 technical bulletins were developed in this year.

Activities of NATP-2 (Preparation Facility):

- Completion of PCR of NATP: Phase-1
- Preparation of DPP of NATP-2
- Preparation of Procurement Plan with SEPA software
- Preparation of Training Plan
- Preparation Financial cost analysis.

LIVESTOCK

The Livestock Division of BARC is involved in organizing and managing various research and other related activities for developing the livestock sector in Bangladesh. This division is working to achieve the goal of improving nutritional status of the general mass through cost-effective livestock production for increased supply of animal origin food, supporting increased crop production through providing healthy draft animals and biological manure, and helping the rural poor in the generation of employment, income and fuel supply through profitable livestock rearing.

To carry out the mandated responsibilities of BARC and to full-fill the national need the division is entrusted with the duties of planning, reviewing, prioritizing, approving, monitoring, evaluation, supervision and coordination of the livestock research programs implemented by the relevant NARS institution and other institutions including universities, Department of Livestock Services (DLS) and NGOs. The division is providing training and research support to the NARS institution, DLS, relevant faculties of various educational institutions and NGOs. The division is imparting policy support to the relevant NARS institutes and extension agencies. The division is arranging, conducting and participating in training, meetings, and seminars/workshops. The division is also engaged to support national avian influenza/bird flue prevention and control programs, to recruit scientists/officers in NARS institutes, to support researches of NARS institutes, and to support different activities of National Agricultural Technology Project-DLS Unit.

PROJECT DEVELOPMENT/FINANCING

Research projects under funding from NATP-SPGR

Project Completion Report (PCR) of 9 SPGR sub-projects were finalized and printed in different times (by PI's/Coordinator). There were Annual progress report of three Research Grant Projects under Livestock

Division submitted by the PI's. Summaries of the Annual progress reports of two projects are given below.

Research projects under funding from Research Grant:

There were a total of 3 on-going research projects from Bangladesh Agricultural University (BAU) and Haji Danesh Science and Technology University, funded under Research Grant of BARC. These research projects developed with the leadership/co-ordination of Livestock Division, BARC. Livestock Division, BARC was directly involved for overall coordination, supervision and regular monitoring of these project activities. Fund release and brief progress of these projects during the year 2013-2014 are given below.

Isolation, Identification and characterization of the etiological agent of infectious coryza in chicken and development of its effective remedial measures: Vaccine development part of the project was not completed because of the change of Principal Investigator. The second P.I. took much time to be oriented of the project works. Before going to develop an inactivated vaccine, the viability of stock broth culture of *Avi. paragallinarum* was checked by putting the culture on blood and chocolate agar plates supplemented by 0.0025% NAD (nicotinamide adenine dinucleotide) and incubated for 24 h at 37°C in 5% CO₂. The organism produced characteristic dew drop like colony. Then again cultured on blood agar plates with *Staphylococcus* as a feeder colony, the organism produced satellitism. Then broth culture of *Avi. paragallinarum* serially diluted in physiological saline and a droplet from each dilution was placed on Chicken Meat Infusion (CMI) agar supplemented by 0.0025% NAD and incubated at 37 °C for 48 h in CO₂ incubator. The number of the Colony Forming Unit (CFU) was calculated in each dilution. The broth culture was adjusted to contain at least 10⁸ CFU/ml. Further works are in progress. However, the period of the project is already over. The P.I. is still working with previously purchased chemicals and reagents.

Molecular characterization of *B. anthracis* isolated from the field cases of Bangladesh and selection of vaccine candidates: *Bacillus anthracis*, the causal agent of anthrax, is a soil-borne, spore forming bacterium. We isolated and characterized *Bacillus anthracis* spores of soils collected from Sirajganj district, Bangladesh. The bacteria were isolated and primarily identified as *B. anthracis* using selective

Polymyxin B – Lysozyme – EDTA – Thallous acetate (PLET) agar.



A multiplex-PCR method targeting three genes; *rpoB* of genome, *pag* of pX01 and *cap* of pX02 was done. Among 72 soil samples, the viable *B. anthracis* spores were extracted from 14 (19.44%) samples. All the isolates were confirmed by multiplex-PCR. Two different band patterns (208-bp and 359-bp) were observed for genome, indicating the presence of genome of *B. anthracis* genome, whereas only a single band (359-bp) was found in the case of *B. subtilis* (negative control). Presence of both pX01 and pX02 plasmids in Bangladeshi isolate of *B. anthracis* was confirmed by partial amplification of *pag* gene of pX01 and *cap* gene of pX02 plasmids. However, both pX01 and pX02 plasmids were harbored in 5 (6.94%) isolates. On the other hand, pX01 or pX02 was present in 8 (57.14%) and 11 (78.57%) isolates, respectively. This two-step-method was found to be easy, accurate and rapid in identification of *B. anthracis* spores from soil samples, and to identify the toxigenic plasmid. In conclusion, for the first time in Bangladesh, we could identify the presence of both pX01 and pX02 plasmids in *B. anthracis*.

Production of algae to use as environment friendly feed supplements for poultry:

Aquatic algae (*Spirulina platensis*) contains higher amount of micronutrient like protein, carotenoids and other micronutrients. It may grow in different organic media (eg, agro-industrial wastes such as sugar mill waste effluent, poultry industry waste, fertilizer factory waste, and organic matter) or inorganic medium (N, P, K, Mg, S, Fe, Ca, Zn, Cu, and Mn). It has high growth potential and abundantly growing throughout the world. It assimilates CO₂ and emits O₂ during photosynthesis in the presence of light. So, algae would have potential use in poultry feed to increase production and improvement of product quality after

growing in artificial media. Considering the point *Spirulina* was cultured in inorganic media (Kosaric media) contained different macronutrient like NaHCO₃, K₂HPO₄, NaNO₃, K₂SO₄, NaCl, MgSO₄.7H₂O, CaCl₂, and FeSO₄.2H₂O as well as micronutrient H₃BO₄, MnCl₂.4H₂O, ZnSO₄ .7H₂O, CuSO₄ .5H₂O, MoO₃, CoCl₂.6H₂O. Media was autoclaved and *Spirulina* was cultured for 12 hours lighting and giving continuous aeration for 15 days to use in poultry feed along with culture. One hundred and forty four day old broiler chick was reared offering starter mash diet for 7 days.



Afterwards birds were divided into 6 groups having 24 birds in each (8 per cage). Birds were offered 1. Control diet, 2. 75% Vit-Min+25% *Spirulina*. 3. 50% Vit-Min+50% *Spirulina* 4. 25% Vit-Min+75% *Spirulina*, 5. 0% Vit-Min+100% *Spirulina* and 6. 0% Vit-Min+0% *Spirulina* (negative control). *Spirulina* was calculated on DM basis added minerals in the media. After 21 days (28 day old) final body weight was 1001, 1070, 1044, 1065, 1163 and 871 g/bird in group 1, 2, 3, 4, 5 and 6 where significantly (p<0.5) higher weight observed in *Spirulina* group (5) but lower in negative control (6) and control group (1). But feed intake observed more or less similar in all the groups (1483±24 g; p>0.5). Feed conversion ratio (kg FI/kg LWG) observed significantly different like 1.79, 1.62, 1.67, 1.61, 1.51 and 2.06 in group 1, 2, 3, 4, 5 and 6 respectively. Where significantly (p<0.5) higher in negative control group (6) and control group (1), but was lowest in highest *Spirulina* group (5). In Bangladesh *Spirulina platensis* culture would be possible at laboratory scale using Kosaric media. Rotten tomato would be a good organic source for its culture. Considering growth performance of broiler complete replacement of vitamin mineral premix would be possible by *Spirulina* culture in broiler diet. Further research is needed for confirmation, economic and feasibility to recommend in diets of different poultry species.

Core Research Activities of NARS Institutes (BLRI)

The Livestock Division of BARC is responsible for scrutinizing and coordinating the core research programs of Bangladesh Livestock Research Institute and devoted itself performing the following duties:

- Reviewed the annual research programs and suggested improvement avoiding wasteful duplication.
- Provided technical support and guidance based on national policy and demand in planning the institute's research programs.
- Done field level monitoring and evaluation of the core research projects to provide technical support and to suggest further improvement.
- Participated in the review workshops, board of Management meetings, different technical committee meetings, recruitment of scientists and other staffs of the institute.
- Done mid-term evaluation of the on-going research projects.
- Done annual evaluation of the completed research projects.

Research Highlights of NARS

Among the various other agencies and institutes, Bangladesh Livestock Research Institute (BLRI) is the only NARS institute working with the mandate of identifying and solving the basic problems of livestock development through research and demonstration in the country. BLRI, with its other various jobs is working to develop -

- suitable methods for quick diagnosis and treatment of various livestock diseases;
- appropriate technologies for production of suitable vaccines and biologics;
- appropriate health management and control methods for different livestock and poultry diseases;
- appropriate food hygiene and safety technologies and herbal medicinal drugs;
- suitable breeds of livestock and poultry for increasing production of milk, meat and eggs;
- suitable feeds and fodder varieties with their production, improvement and preservation techniques;
- suitable storage facilities and marketing systems for the livestock products and byproducts.

With the above-mentioned research mandate, BLRI conducted a total of 36 research projects/programs

during the year 2014-2015. Research highlights of some these projects/programs are given below:

Study on improving feed efficiency of Pabna and RCC bulls;; 1.a: Comparative study on feeding values of sole Moringa and other available roughages: Roughage feed plays an important role in the development of diets for beef cattle, as it directly or indirectly determines the diet cost and influence animal performance. Seeds of Australian Sweet Jumbo and Maize fodder (BADC, hybrid) were procured from local authorized sources and sown in the fields at Pachutia Fodder Research Plot, BLRI, Savar, Dhaka, Bangladesh following all the recommended and standard agronomic practices. Australian Sweet Jumbo was harvested manually at the flowering stage of maturity (at 75 days after sowing) and Maize harvested at dough stage (at 90 days after sowing). After harvesting, Australian Sweet Jumbo and Maize fodder were chopped into 6-8 cm using a chopper machine and ensiled in earthen pit for 30 days. Moringa plant fodder was collected from BLRI fodder research plot. Fresh Moringa plant fodder was chopped using a chopper machine; sun dried for 3-4 days and grounded using a roughage grinder machine.

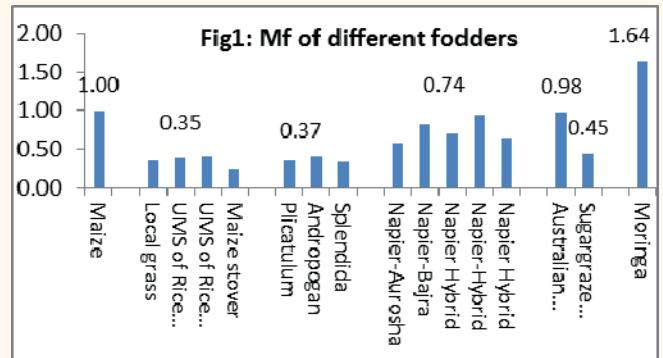


Three different types of roughage i.e., Moringa plants fodder, Australian Sweet Jumbo and Maize were randomly fed to 18 local growing bulls of

103.8 ± 25.5 Kg live weight dividing into three equal groups. The animals were housed individually and fed only the roughage diets *ad libitum* for a period of 75 days; first 15 days was given for the adjustment of feed and experimental conditions. The animals were weighed at an interval of 10 days, and their feed intake, digestibility of nutrients and growth performances were used for comparing the nutritional qualities of different roughages. Moringa plants fodder had a highest average daily gain of 376.0 g compared to 289 g of Maize silage and 218 g Jumbo silage diet. The average feed conversion efficiency (FCR) of the animals was 8.85, 11.52 and 13.08, respectively. The cost involvement of Kg live weight gain of bulls fed Moringa plants fodder, Maize and Australian Sweet Jumbo were Tk. 104.0, 122.0 and 132.0, respectively indicating Moringa foliage fed animals had a lower feed cost compared to Maize or Australian Sweet Jumbo. Considering the nutrition quality of roughages and the cost of beef production, the three different roughages were ranked as Moringa plant fodder > Maize silage > AS Jumbo silage showing a nutritional coefficient of 1.30, 1.0 and 0.88, respectively.

1.b. Biometrical ranking of available fodder crops: Fodder production practices have been increasing recently even having limitations in land availability. Many of the fodder crops have been becoming profitable to farmers keep farm animals or even to farmers cultivate fodders and harvest fresh biomass for marketing locally. Different seed marketing organizations import seeds of different fodder crops and market them locally taking certification of the Seed Certification Agency (SCA) of the country. The authorization system of introduction of new fodder species in the country, in addition to seed quality, must consider the production and productivity of fodder biomass and its response to animals. This requires enforcing of

legal authoritative power of the Department of Livestock services (DLS) in certification system. To make the whole system effective, a database on the quality of different fodders in terms of efficiency of biomass or animal production or benefit & cost ratio or reduction of energy loss as enteric methane in the rumen is required to be developed through careful screening of the available fodder crops in the country. Thus, a research work was undertaken on the development of biometrical ranking systems of available fodder crops in the country. The fodder crops available in the fodder germplasm bank of the Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka were cultivated, conserved and used here. Maize was considered to be a control roughage feed while a series feeding trials were conducted on native bulls. The Maize Indices (M_f) of available fodder crops, thus developed, are shown in Fig1. Local grass, Urea and Molasses mixed Straws and Maize Stover, Plicatulum, Andropogon, and



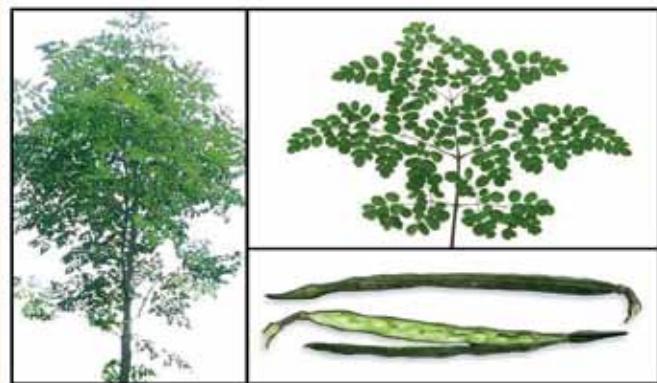
Splendida had 0.25 to 0.41 M_f ; and among the different varieties of Napier Aurosha had 0.57 and others M_f varied from 0.70 to 0.94. They, including Sugargraze (0.45), were poorer in quality roughages than fodder Maize. Moringa showing 1.64 M_f was the most quality fodder considering the efficiencies of production of biomass, benefit to cost & animal; and reduction of enteric methane in the rumen compared to fodder Maize. Farmers may use this Maize index (M_f) or roughage ranking tool in formulating cost effective diets for making more profit of cattle production.

Moreover, it may be used for a certification system to be developed by the concerned authority for releasing fodder crops or seeds for cultivation in the country.

1.c: Feeding effects of increasing concentrate levels with different quality silages on beef production performance of native growing bulls: Farmers aim at achieving of higher productivity along with lower feed consumptions. In intensive beef production, grass silage is typically supplemented with concentrate as the main source of fermentable carbohydrates in order to improve production efficiency and to increase energy and nutrient intake of growing bulls. To produce low price meat and obtain optimum growth, roughage to concentrate ratios in diets should be optimized. Thus, the present study was undertaken with the objectives to quantify optimum concentrate level with different quality silages and harvest maximum growth performances of local growing bulls. A feeding trial comprised 48 local bulls with initial live weight of 205.08 ± 43.24 Kg were randomly allotted to receive 8 dietary treatments. The concentrates mixture used in the trial composed of crushed maize (12%), wheat bran (35%), Khesari bran (15%), til oil cake (15%), soybean meal (18%), common salt (2%), and dicalcium phosphate (3%). A vitamin mineral premix was added at a level of 0.1% in the concentrate mixture. Animals were housed individually and offered daily rations as two equal portions at 9:00 and 16:00 h. Fresh water was made available in the sheds for experimental animals. The experiment lasted for 75 days included the first 15 days adaptation period was given in which the animals got adjusted to various diets and the rest 60 days was considered for feeding trial. Irrespective of silage type, the average daily gain (ADG) and feed conversion efficiency (FCR) improved with increasing concentrate levels in the diets. The average daily gain in bulls fed Maize silage & concentrate of 100:0.00, 75:25, 50:50 and 25:75 were 406, 697, 849 and 821 g, respectively. Similarly, the average daily gain of animals fed Australian Sweet Jumbo silage to concentrate ratios of 100:0.00, 75:25, 50:50 and 25:75 were 284, 343, 504 and 677 g, respectively. Similarly, concentrate level increased ADG and FCR in AS Jumbo silage diets showing a varying level of growth response from that of feeding Maize silage. Bulls fed Maize silage with graded levels of concentrate tended to have higher ADG (693 g) and better FCR (8.6) compared to ADG (452 g) and FCR (12.5) of Australian Sweet Jumbo with graded levels of

concentrate. As concentrate levels increased, feed cost Kg live weight gain estimates also increased. Incase of maize silage, the feed cost analysis indicated that, silage to concentrate proportion up to 50:50 was more profitable for Kg live weight gain. For feeding Australian Sweet Jumbo, silage to concentrate proportion of 75:25 was profitable in terms of Kg live weight gain. Therefore, it may be concluded that, feeding maize was more cost effective and better than Australian Sweet Jumbo. The supplementation of concentrates up to 50% for maize and 25% for Australian Sweet Jumbo was profitable for fattening program.

Study of Moringa plant fodder agronomy and its feeding to ruminants: Fibrous feeds and cereal by-products available in the country may support an average diet of 7.74 MJME/Kg DM and 2.32% digestible crude protein (Huque, 2014) having metabolizability not exceeding 0.4, an unlikely plane of nutrition supports farmers' slogan of more milk from a cow or more meat from a bull. High yielding food producing animals must get support of diets of higher nutrient concentration and metabolizability, and it requires annual supply of high ranking feeds and fodders, like Alfalfa;



that are extremely unavailable in the country. Science and research, so far, strongly recognizes *Moringa oleifera* as a high ranking plant fodder for food producing farm animals but, year round production and supply of its biomass to farmers is still challenging. It requires systematic screening of available germplasm of Moringa, on-farm system of production confronting unreasonable debates on using continuously disappearing cultivable land, and value additions for market availability of Moringa feed. It was found that Black (BSM) compared to White Seed Moringa

(WSM) is more suitable for fodder biomass production throughout the year having peaks in biomass production during March to October along with discoloration and defoliation of leaves during pouring in the monsoon in well drained sandy & loamy soil, and its growth stunts during winter months (December & January). Moringa seeds may be collected during June and July, and having 70% to 80% germination rate saplings may be raised in polythene bags and they may be transplanted in lines of well ploughed land at plant density of 200000 to 250000 saplings per hectare. The seed germination rate declines to 30% in the following year, seeds and saplings may be infected with fungus (*Chaetomium globosum*, *F. Oxysprm*, *Aspergillus flavus*, *Penicillium sp* & *Rhizopus sp*). They cause dieback of Moringa and may be prevented by using appropriate pesticides. Growth compensation after spring rainfalls minimizes benefits of irrigation during the winter when growth declines but weeding helps biomass production cost effectively. Lopping of plants at 40cm height at a plant density of 250000 plants/hectare may yield 40 ton dry matter $\text{ha}^{-1}\text{year}^{-1}$ at an initial growth period of 120 days followed by eight harvests in the rest of the period of a year. Urea fertilization increases biomass production up to a level of 90 Kg urea nitrogen/hectare. Moringa feed containing 18.6% crude protein (CP) and 34.3% acid detergent fibre (ADF) is 1.64 times better in terms of its production performances of biomass, its feeding response to farm animals, reduction in enteric CH₄ emission and feed cost than Maize silage. Further research and demonstration on-farm may establish Moringa plant as high ranking fodder cost effective feed in the country.

Selection of suitable exotic beef breed(s) and performance evaluation of their crosses with native cattle: Bangladesh has a great demand of beef. In the last few years, the price of beef in Bangladesh is increasing tremendously due to insufficient production and supply of beef and the low carcass yield of native cattle. The conventional beef production system coupled with intensive beef farming may help increasing beef production. Profitable beef production under intensive farming is largely depended on the productivity of beef animals. Brahman crosses are

being produced to support increased productivity of the animals, but strategic approach for breed development that needs screening of multiple genotypes is ignored. Thus, along with Brahman some other exotic beef sires were selected to produce cattle genotype for beef production cost effectively. To achieve the objectives of the project, 76 straws of frozen semen of Simmental (red), Charolais (white) and Limousin (light wheat to darker red) were procured from Australia. Furthermore, a total of 25 doses of American Brahman supplied by DLS were also introduced under this breeding program. To determine the best performing exotic beef breed(s) for production of 300.0 kg live weight progeny at 2 years of age, a total of 40 native dam of BLRI Cattle Breed-1 (BCB-1) was selected. Two years of age; an age limit for sacrificing cattle especially from the social and religious point of view of the consumers. For genetic variation study, a total of 93 blood samples from 4 generations of BCB-1, Sirajgong, RCC and Sahiwal as control were collected. The ISAG-FAO recommended 20 bovine microsatellite markers were selected for this study. Up to now, a total of 51 numbers of AI were performed. Out of 28, 23 were diagnosed for confirm pregnancy. The non-return rate was calculated based on first-service and the value was as 71.42 %. The first-service conception rate was calculated as 56.52 %. The service per conception rate was estimated as 1.28. About 64 % cows and heifers are pregnant to deliver their calves and out of them a total number of 4 crossbred progenies of Limousin, Charolais and Simmental are produced in the farm. Finally, a suitable beef cattle genotype that will yield an average carcass weight of 150Kg by 24 months of age will be developed.

Study on livestock manure management practices in Bangladesh and their impacts on climate: Livestock manure, containing up to 45% of dietary nutrients, used mostly as fertilizer and burned fuel, and pollutes environment threatening public health. It was found that about 75.2% of livestock manure before using in crop fields kept in solid storage allowing annual emission of 5.645 kg CH₄ per animal. Manufacturing of cakes and sticks using manure in addition to burning allow

annual emission of 7.62 kg CH₄ per animal. Liquid slurry, another form of livestock manure, consists of farm wash and effluents, estimated to be 1.65% of the total manure, remains unused in open lagoons or fields and contributes annually 4.978 kg CH₄ per animal. Anaerobic digestion, a recently introduced livestock manure based biogas production system, has been using about 4.80% of the total manure, that allows emission of only 0.56 kg CH₄ per animal annually in the environment, and help alleviation of climate pollution to some extent. It empowers women, improves public health and sanitation system. Without litter, a system of manure management, specifically, used for poultry farming, contributes annually 0.0198 kg CH₄ per bird. The above livestock manure management systems contribute a total annual emission of 150.08 kg CH₄ in the country. However, globally livestock manure is considered as sources of nutrients and new energy, and that may widen the basket of key performance indicators of livestock in addition to milk, meat and eggs, and help production system more profitable, environment friendly and sustainable. Bio-fertilizer, improves soil health and reduces chemical fertilizer use or bio-condensed natural gas, that may save fossil fuel use to some extent; are yet to be adopted in livestock farming systems. This requires undertaking strategic approaches for livestock manure management in the country that needs formulation of policies and action plans keeping consideration of other related policy document of the country.

Avian Influenza Viruses Monitoring in Possible Bridge Species of Wild and Domestic Birds in Bangladesh: Avian influenza virus was identified from possible bridge species of wild and domestic birds and concurrently the virus also isolated from HPAI vaccinated chicken flocks in Bangladesh. A total of 2993 swab samples from possible bridge

species of wild and domestic birds, 132 swab, 132 serum and 8 trachea samples from dead birds of HPAI vaccinated chicken flocks of different districts of Bangladesh were collected. Results showed that duck, native chicken, migratory bird and heron act as bridge species for avian influenza virus. H5N1 HPAI virus was isolated from duck, commercial chicken and quail. Novel H7N9 AIV was not found during this study. HPAI H5N1 is still circulating in Bangladesh but H9N2 LPAI is dominantly circulating. Sequence analysis of the H5N1 isolates of the 2014 revealed that isolates belonged to 2.3.2.1a clade which is different from previous circulating clade 2.3.2.1. H5N1 HPAI was isolated from vaccinated flocks which indicated that HPAI vaccinated chickens can be infected with HPAI or other subtypes of avian influenza virus.

Prevalence of *Salmonella* spp. in poultry and poultry products in Savar Upazilla of Bangladesh: The study was undertaken to determine the prevalence of *Salmonella* spp in poultry and poultry products in Savar Upazilla of Bangladesh. A total of 355 samples comprising 150 cloacal swabs of poultry, 50 egg shells and egg content from 50 eggs, 30 intestinal content, 30 liver swabs, 30 broiler meat samples and 15 swabs from slaughter house were collected. Out of 355 samples, over all positivity was 25.35%. 32% cloacal swab samples of poultry, 28% egg shells, 0% egg content, 36.66% intestinal content, 23.33% liver swabs, 20% broiler meat samples and 26.66% swabs of slaughter house were found positive for *Salmonella* spp. Ready-to-eat foods should be free of *Salmonella* spp. So, the presence of *Salmonella* spp in poultry and poultry products is harmful for human. Continuous monitoring & improvement of biosecurity in poultry farms and proper cleaning & disinfection of slaughter houses can improve the prevalence of *Salmonella* spp. in poultry and poultry products.

A pilot project on Peste des Petits Ruminants (PPR) control in selected areas of Bangladesh: Peste des Petits Ruminants (PPR) is a highly fatal viral disease of

goat and sheep in Bangladesh. The pilot project on PPR control was implemented in 5 selected villages of Jessore and Manikgonj district. After awareness building among farmers on PPR, a mass vaccination program (where 5000 goats were vaccinated) was carried in all goats of over 2 months of age after initial sero-surveillance. After 15 months of vaccination, the average antibody titer was 90% at vaccinated villages and 58% at control villages. Goat farmers of vaccinated villages gained BDT 13,300 per household. Kid population increment at vaccinated villages was 92.4% and in control villages was 57.75%. It is reflected that locally produced PPR vaccine confers sufficient herd immunity that can protect PPR disease in goat. Highlights of the technology are (a) All goats and sheep over 2 months of age should be vaccinated at a time (b) Vaccination must be finished within two hours after vaccine dilution (c) Broad-spectrum anthelmintics should be provided to goats every 4 months of interval and along with other health management must be followed (d) Cool-chain should be strictly followed during vaccine collection, transportation and preservation.

Development of biologics for the diagnosis of Peste des Petits Ruminants (PPR): In Bangladesh, Peste des Petits Ruminants (PPR) was first detected in the year 1993. Due to lack of molecular PPR virus diagnostic technology in the field level of Bangladesh, a polyclonal antibody (Pab) based specific, sensitive and rapid diagnostic test has been developed to detect the PPRV antigens from field samples at field condition. PPR virus can be detected from nasal, ocular and feces samples of PPR suspected goat by Pab based technique. This technique was tested at room temperature in the field level. Pab based PPRV detection system can be used as useful and low cost technique for the diagnosis of PPR outbreak in the field which will be helpful for the control of PPR disease in Bangladesh. Characteristics of the technology are (a) PPRV can be detected in the field level within one and half hours (b) Pab was used instead of Mab (c) glass slide was used instead of polystyrene ELISA plate (d) low cost technology.

Marketing and Value Chain Analysis of Live Poultry in Savar Upazila: Savar upazila is the leading area of poultry production and trading in capital city Dhaka and its surrounding districts. Various poultry farmers incurred production cost per quintal of live poultry were BDT 7,300, BDT 17,063 and BDT 9,488, respectively for native chicken, sonali and broiler which indicating that native chicken rearing is based on scavenging that requires low production cost compared with broiler and sonali production. The average production cost was BDT 11,283. Per quintal net return was found BDT 5,182, BDT 3,714 and BDT 1,123, respectively for native, sonali and broiler meaning that rural women keeping native birds in their backyard as additional income. The average net return was BDT 3,340. Majority of the consumers (56%) showed negative opinion in case of processed poultry meat and remaining (44%) had positive attitude. Process poultry meat market development is a tameable decision. As live poultry marketing brought serious health diseases where near about 58% of market actors suffered different diseases. For sustainable and environment friendly poultry production and business, it needs to follow bio-security, halal method and hygienic way of poultry processing.

Evaluation of existing livestock and poultry policies and provide guidelines for development in Bangladesh: This study was undertaken to identify the gaps between existing policies and expectations from the perspectives of stakeholders. At this stage animal slaughter act, feed act and poultry development policies were considered for investigation. Total 377 respondents interviewed in addition seven FGDs (Focus Group Discussions) and some Key Informant Interviews (KII) was administered with different stakeholders in seven divisions of Bangladesh. The survey result revealed that the proportion of farmers having Govt. registration was 36% whereas in case of hatchery owner it was 100%. Fifty eight percent farmers said that they do not have any idea about slaughter act whereas 85% farmers said sanitary inspector never visit slaughterhouse. More than 80% butchers said they used antibiotics, hormones and opined that slaughterhouse is not environment friendly. More than 82% meat processor said that they did not have modern facilities for the processing plant. Regarding feed act, about 70% farmers said that feed prices are fluctuating throughout the year. About 70%

said that there was no lot number to identify animal feed. More than 80% dealers and distributors said they did not see any authorized officers visiting and collecting feed samples for quality testing which is the violation of animal feed act. Knowledge about Feed Act is considered as binary (dependent variable) and others as endogenous variable. None of these endogenous variables have significant effect on the knowledge of farmers about slaughter act except education as $P < 0.05$ and also knowledge about poultry development act. So the educated farmers have higher probability of getting known about the feed act. The most of these endogenous variables are insignificant. Only yearly income is significant at 5% level of significance as $P < 0.05$. So it may indicate that distributors with higher income have the probability of getting known about the poultry development act. It can be concluded that the population of respondents in particular area that less than 50% of them have knowledge about feed act, slaughter act and poultry development act. Proper implementation of act and policies will help ensure livestock sector development in Bangladesh to a great extent.

Laying performances of BLRI layer-2 (Shorna) under farmers condition: Bangladesh Livestock Research Institute (BLRI) has been developed 2nd layer strain having brown egg shelled named BLRI layer-2 or "Shorna" with the auto sexing advantage and considering the more market demand of brown layers. The on-station trial of the strain found encouraging. After that the field trial of the strain (from day old to 72 weeks of age) at different locations (Sarishabari, Jamalpur; Babuganj, Barisal, and Kalihati, Tangail) of the country were performed. The average egg laying performances were – auto sexing - 100%; age at first egg- 135 days; live weight at 20 and 70 week of age 1530 and 1950 g/bird respectively; feed intake-118g/bird/day; annual egg production- 280egg /hen; total egg weight- 18 Kg per hen per year; egg weight at 72 week- 70g; feed conversion efficiency - 2.32 and mortality -3 %) (production period). Considering the above results particularly auto sexability at day-old, annual egg production, feed intake, total egg weight, feed conversion efficiency and livability of the BLRI layer-2 (Shorna), it may be suggested that the layer strain seems to be promising for commercial production.

Detection of heavy metals in poultry feed, meat and eggs: The poultry feed, meat and egg samples were collected from the major poultry raising areas of the country to know the presence of heavy metals especially

arsenic (As), lead (Pb) and chromium (Cr). A total of 360 elemental samples for As, Pb and Cr were analyzed in the laboratory. The heavy metal contents (As, Pb & Cr) of all the tested samples were found positive. But, the levels were below the Maximum Permitted Concentration (MPC) in most cases. The layer and broiler ready feed samples found safe from those elements; On the other hand, the "Cr" and "Pb" content in 14% and 11% loose feed samples were 7-70 and 3 times higher respectively than that of MPC. Notes worthy, the egg samples were also found safe from those elements. Of the tested samples 14% broiler meat and 50% spent hen samples found slightly higher level of "As" and 4-6 times "Cr" respectively than the MPC. In conclusion, the poultry farmers are suggested to buy poultry feeds from the reputed feed company and discourage to use loose feeds. Moreover, feed marketing channel particularly loose feed marketing should be monitored properly by the regulatory authority.

Conservation and improvement of native chicken; a.

Performance of fourth generation: Study was conducted at Bangladesh Livestock Research Institute, Savar, Dhaka with the objectives (i) to assess the performances of three Indigenous Chicken genotypes under intensive management, (ii) to select parental birds (males and females) and breed them in an assortative design for the production of fourth generation birds, and (iii) to estimate realized responses to selection to improve 3 Indigenous Chicken genotypes. A total of 1050-day-old chicks comprising of 3 types of chicken namely Naked Neck (NN), Hilly (H) and Non-descript Deshi (ND) were hatched in one batch for this study. In fourth generation (G_4), selection was practiced at 40-week of age on the basis of an index comprising the parameters of age at first egg (AFE), body weight (BW), egg production (EP) and egg weight (EW). Improvement target of egg weight was to increase by 1g, egg production rate was to increase by 2 % per generation. Day old chick weight was significantly highest in H (32.73 ± 0.60 g). Significant body weight differences among the genotypes were observed at 4th, 8th and 12th weeks of age, with the highest body weight observed for H genotype (252.66 ± 2.05 , 674.68 ± 6.41 and 1193.74 ± 36.34 g) than other two genotypes in all stages of age. The realized responses in terms of changes in breeding values in egg production and egg weight over generations were 0.722% and 5.349g, respectively. However, the results indicated that the genetic improvement of Indigenous Chicken for egg production

will be effective through selection and breeding program. It may be concluded that the economic traits of Indigenous chicken could be improved in future generations through proper selection and planned mating.



Conservation and improvement of Quail; a. Performance of fourth generation

Four genotypes of quail like Japanese (J), White (W), Black (Bl) and Brown (Br) quail are being maintained at BLRI with the objective to develop a suitable meat type quail genotype for our existing farming. The parent males and females were being maintained in cages for single pair mating through close breeding system for production of its generation. For production of fourth generation (G_4), parent quails of each genotype were selected from the 3rd generation (G_3) on the basis of breeding value according to their 6th week body weight. Hatching eggs were collected from every single pen of the selected parent quails. A total of 1876-day-old chicks comprising of 4 types of quail namely J, W, Br, and Bl were hatched in one batch. Body weight of quails at 2nd, 4th, and 6th weeks of age were significantly influenced by genotype. Significantly higher body weight was found in W and Bl followed by Br and J quail genotypes at different period of age. The hatchability rate were significantly higher in J (67.41%) compared to other three genotypes of W (61.30%), Br (65.26%) and Bl (45.25 %), respectively. Feed intake was not affected by genotype but egg production was significantly influenced by

genotype. Selection differential varied from 4.0g body weight in Black quail male to 13.1g body weight in Brown quail male. Phenotypic standard deviation varied from 6.8g in Black male to 15.3g in White female. The intensity of selection varied from 0.36 to 1.10 in this population. Based on the performances, W and Bl quail were superior for body weight and Bl quail for egg production. These findings give us more attention for continuing the quail breeding research for production of a suitable meat type quail genotype in our country.



Conservation, improvement and feeding system development of native duck genotype: This study was undertaken to evaluate the laying performance of BLRI developed native duck (G_1) and vis-a-vis to develop the feeding system of native duck in hoar areas. For next generation (G_2) a total of 550 Rupali and 260 Nageswari ducks were hatched. Production and egg quality performance of generation 1 revealed that Nageswari duck starts laying at higher age (153 days) compared to Rupali duck (149 days) genotype. Duck weight at sexual maturity and egg weight at first lay were also higher in Rupali than Nageswari duck but egg production (24-48 weeks) was found almost similar in both genotypes (Rupali 97.36 and Nageswari 98.72 in number respectively). Rupali duck produced heavier eggs (66.37 g) than

Nageswari (63.47 g) duck. In egg quality aspects HU, yolk index, shell thickness and breaking strength found no differences among the genotypes. The average initial body weight of day old ducklings of Rupali and Nageswari were 33.3 and 32.67g respectively. Meandaily and total gain at 0-8 weeks of age were 24.92 and 22.45 and 1231.43 and 1166.28 g respectively for Rupali and Nageswari duck genotypes. There was no variation in feed intake and FCR among the duck genotypes.

Duck production and evaluation of feeding system were studied at Nasirnagar in the district of Brahmanbaria. The main objectives were to evaluate the existing feeding system and identify the major problems and make a short profile of duck farmer's of that upazila. Surveyed results showed that majority of the farmer(15.87%) included in young aged group and most of the farmers (12.70%) did not receive any education and also showed that 16.17% of the duck farmers were housewives. Most of the land of the farmers (1554.76 dcm) belongs to middle group. The larger number of duck (2207.14) belongs to the group three (>1000) practiced distant grazing 6.30 months. Dependency on natural feeds, maximum (64.17%) occurred in 1st (5-500) group and major (55.00%) dependency on ready feed occurred in 2nd group (501-1000) and maximum profit gain from group three (>1000).



Farmers fill up the questionnaire

Study on the performances of Boer and Jamunapari goat at BLRI:

The objective of the study is to evaluate the productive and reproductive performances of pure Boer goats and their progenies compared to that of the locally available Jamunapari goat under Bangladesh conditions. The study was conducted at the Goat Research Station of BLRI, Savar, Dhaka from January 2014. The body hair coat color of Boer goat was white with reddish-brown heads, ears and necks and the body hair coat color of Jamunapari goat was variety of color. Both Boer goat and Jamunapari goat have horn. The body weight was significantly ($P<0.001$) differed between Boer goat (52.36 ± 5.97 kg) and Jamunapari goat (39.26 ± 3.00 kg). The Body length, height at wither, chest girth and ear length of Boer goat were 69.96 ± 2.09 cm, 67.98 ± 1.19 cm, 78.39 ± 2.04 cm and 19.43 ± 0.90 cm, respectively where as Body length, height at wither, chest girth and ear length of Jamunapari goat were 72.13 ± 1.63 cm, 69.69 ± 1.29 cm, 79.18 ± 2.04 cm and 21.23 ± 0.66 cm respectively. The Birth weight was significantly ($p<0.001$) differed between Boer goat (3.40 ± 0.23 kg) and Jamunapari goat (1.73 ± 0.08 kg). The growth rate of Boer goat (0.168 ± 0.01 kg/d) was significantly ($p<0.001$) higher than Jamunapari goat (0.070 ± 0.00 kg/d). The weaning weight of Boer goat (18.50 ± 1.42 kg) was significantly ($p<0.001$) higher than Jamunapari goat (7.90 ± 0.23 kg). The weaning age of Boer goat (90.40 ± 2.82 days) was significantly ($p<0.001$) lower than Jamunapari goat (127.30 ± 7.19 days). The litter size was significantly ($p<0.01$) differed between Jamunapari goat (1.89 ± 0.16) and Boer goat (1.52 ± 0.07). The kidding interval of Jamunapari goat (226.50 ± 13.24 days) was significantly ($p<0.05$) lower than Boer goat (272.85 ± 12.78 days). The post partum heat period of Jamunapari goat (63.00 ± 7.00 days) was

significantly ($p<0.001$) lower than Boer goat (145.33 ± 43.88 days). Phenotype wise Boer goats have distinct meat characteristics and have higher birth weight, growth rate, weaning weight. However, litter size and kidding interval were significantly lower in Boer goats than Jamunapari goats.

Production of calves through transfer of *in vitro* produced cattle embryos: Ovum pick up based *in vitro* embryo production (OPU-IVP) technology is used for rapid multiplication and distribution of high yielding cows. The technology hasten genetic progress through increasing population size of high yielding cows. Considering this facts, BLRI is conducting researches on OPU-IVP for distribution and production of high yielding dairy cows. The oocyte aspiration protocol, ovarian follicular dynamics and IVP protocol were adopted at BLRI. The present research was designed to produce calves through transfer of IVP embryos. To achieve the above objective, IVP embryos were produced and transferred into 5 recipient cows. Estrus of recipients were synchronized and two embryos were transferred per recipient. Result showed that, the pregnancy rate at 60 day following embryo transfer was 20%. Successful adoption of the technology and its on-farm application will facilitate dairy development in Bangladesh.

Conservation and improvement of Munshiganj Cattle: Among the prospective varieties of indigenous cattle genetic resources in Bangladesh, Munshiganj cattle (MC) and Red Chittagong cattle (RCC) are well known for their distinguished genetic and phenotypic characteristics. Although some initiatives have so far been taken to conserve and improve of RCC, but no steps have yet been done for MC. The numbers of MC are declining gradually day by day due to indiscriminate crossbreeding; hence they are under the threat of extinction. Therefore, BLRI has started a project to conserve and improve MC by establishing a mini nucleus herd consisting of 10 cows, 4 heifers and 2 breeding bulls. The performance records so far evaluated found that average estimates of daily milk yield and contents of fat, lactose and solids not fat (SNF) to be 4.5 litres, 5.61%, 6.19% and 11.43%, respectively. Moreover, MC gives birth yearly up to 12-15 calves per life time, have more resistance to diseases and a farmer can easily manage it. Hence, more emphasis should be given to conserve and

improve this valuable indigenous genetic resource in *ex-situ* and *in-situ*.

Development of feeding system and least-cost balanced ration with locally available feed ingredients for different selected regions; a. Development of Feed Master Android Application (Thumb rule Version):

Feeding is one of the most important factors for profitable animal production. Feeding of animal economically requires proper feed formulation according to animal requirement considering their age, sex and stage of production. In conventional animal production system, farmers are not conscious enough about their animal's requirement and available feed sources. So an approach was taken to develop an Android Feed Master Application for farmers as well as stakeholder to feed their animals in proper way.

Conservation and improvement of native buffalo through selection; a. Study on estrous synchronization, conception rate and live birth weight of crossbred & native buffalo calves: Considering fat and total solid contents, buffalo produces two times higher milk than indigenous cattle of Bangladesh. However, their average lactation yield is very low compared to high yielding exotic buffalo breed. The Government has taken "Buffalo Development Project" to improve the genetic potential of indigenous buffalo for increasing milk and meat production through crossbreeding with Mediterian Murrah buffalo. For this purpose, artificial insemination (AI) is conducting in the project areas. However, poor estrus detection in buffalo owing to weak estrus symptom and seasonal estrus, limiting AI efficiency at farm condition. Therefore, this study was conducted to adopt buffalo estrus synchronization protocol along with evaluation of efficiency of ongoing AI programme. Results, showed that, about 80.0% buffalo come into estrus when treated with hormone. Conception rates were higher in buffaloes when AI were done in naturally heated animal (50.91%) than synchronized buffalo (16.67%). Birth weight of crossbred buffaloes (37.15 kg) was higher than indigenous (21.82kg) buffalo calves. The above findings inferred that the efficiency of AI in buffaloes was moderate.

Sheep Project: Conservation and development of locat sheep through community and commercial farming; Community based sheep production in hilly area at Naikhonchari: The study was undertaken to establish the sheep rearing system at hilly region at

Nikhonchari. The study was conducted at BLRI regional station, Nikhonchari, Bandarban. At starting period, a total of 40 ewes and 10 rams of native sheep (4 ewes and 1 ram of each) were distributed to community farmers' level and remaining 16 ewes and 4 rams are being reared at regional station research farm. The socio economic status of selected farmers and productive and reproductive performances of native sheep at farm and community level was studied. The study shows that, the community farmers' income increases from 3000- 22,000/- in the last year. It may be concluded that, in the community level, the BLRI native sheep is being well adapted. The study is going on and more data will be collected up to the significant result.

Development of effective lamb production system in Bangladesh; a. Effect of different plane of nutrition from late pregnancy to lactation stage on the performance of ewes and their lambs until weaning: Thirty-six native ewes between 2 and 5 parity were randomly allocated to four treatment groups (T_0 , T_1 , T_2 , T_3) at about 7 weeks before parturition. Ewes of all the treatment group were supplied *ad libitum* German grass (*Echinochloa polystachya*) but T_1 , T_2 and T_3 group were supplemented a concentrated mixture (Crushed Maize 40%, Soybean meal 26 %, Wheat bran 22%, Rice polish 10%, Salt 1%, Vitamin-mineral premix 0.5% and DCP 0.5%), at 1.0, 1.5 and 2.0% of their body weight, respectively. So, group T_0 considered as control group. Chemical compositions of the experimental diets are presented in the table 1. After parturition, lambs were supplemented a creep mixture (Crushed maize 68%, Soybean meal 30 %, Vitamin-minarel premix 1%, Salt 1%) from the age of 2 weeks at 20g/lamb/day with an weekly increment of 10g /lamb. Beside this, small amount of German grass were also provided to the lambs *ad libitum* basis from the age of 4 weeks. Milk yield were measured over a 24h period by suckling method and repeated weekly over the entire lactation period. The results of this experiment indicated that supplementation of concentrate significantly increase DM intake of ewes, daily gain of lambs and lambs final weight. Comparing different parameters like, DM intake of ewes, lambs birth weight and daily gain with ewes milk production, the group (T_2) fed *ad-libitum* German grass with concentrate at 1.5% of their body weight performed better compare to other groups. Further studies on a larger set of data with higher levels of nutrition during the last stage of pregnancy and lactation are

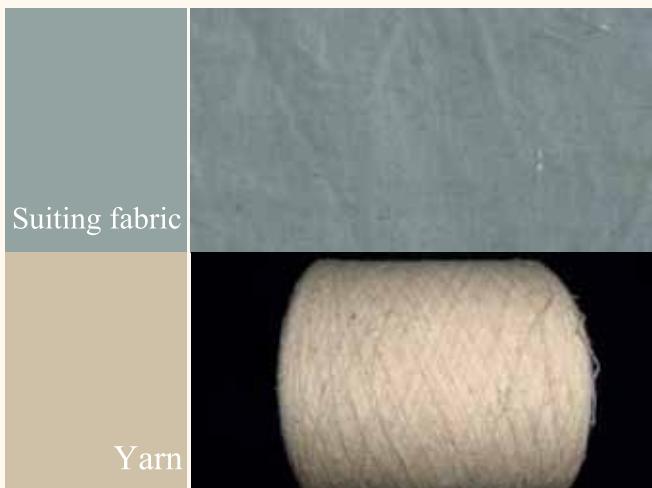
recommended to specify actual trends that influence the study, taking the economic advantage into account.

Establishment of health management package for native sheep of Bangladesh; a. Development of herbal anthelmintic against internal parasites-GI nematodes of sheep: Primarily, it was found from a research conducted on 200 sheep having gastrointestinal nematodes egg per gram (EPG) of faeces ranging from 750 to 3200 that neem (*Azadirachta indica*) leaves, betel (*Piper betle*) leaves, pineapple (*Ananas comosus*) leaves and bitter gourds (*Momordica charantia*) juices (50gm blended in 200ml of clean drinking water in each case) were effective to significantly reduce the EPG counts on day 7 after treatment when used orally once @ 3ml/kg body weight, 5ml/kg body weight and 10ml/kg body weight . So, all four herbal drugs @ 3ml/kg body weight, 5ml/kg body weight and 10ml/kg body weight may be used orally as anthelmintics in sheep population against the internal parasites-GI nematodes. However, the best option is 10ml/kg body weight.

Development of blended yarns and fabrics from jute, cotton and native sheep wool: Wool is a potential by product of sheep which is being used throughout the world for producing yarn and fabrics. A research has been taken for commercial use of wool in Bangladesh through yarn and fabrics production with the joint collaboration of BLRI and BJRI. The aims of the research work are to produce blended yarn and fabrics; determine the physical properties of blended yarns and fabrics; Compare the blended properties with respective 100% cotton, jute and woolen properties and increase the diversified use of wool and cotton blended products with small entrepreneur. In this regard wool was collected from Goat and sheep research farm of BLRI and also different sub-station of sheep project. To produce fine yarn and fabrics wool was mixed with jute and cotton in the ratio of 30:30:40. By using cotton processing system blended yarn was produced. After determination of the properties, yarns were used in weaving machine (loom) to produce blended fabrics. Shawls and pant pieces were produced successfully. Blanket is being produced.



Shawl



Collection, conservation, multiplication of high yielding fodders and evaluation of their production performance under different agronomical practices;

a. Study on the effect of organic manure on production performance of BLRI-Napier-4 and comparative economic analysis of fodder production with rice: Baghabari is one of the important milk pocket areas of Bangladesh has a huge demand of green fodder for dairy cattle production. Traditional green grasses in pasture land have been reducing gradually and the demands of cultivated fodders in these areas are increasing. To enhance production of high yielding cash crops, farmers are supposed to use chemical fertilizers; consequently soil fertility is reducing day by day. To mitigate this problem it is necessary to use organic manures to regain soil fertility. Thus a study was performed to assess the effects of different manures (biogas slurry, broiler litter, layer litter and chemical fertilizer as control) on production performance of BLRI Napier-4 fodder and comparative economic analysis with rice cultivation. Results showed that the ranking of manures based on performance was layer litter>biogas slurry>broiler litter>fertilizer with higher BCR than rice.

b. Effect of feeding different high yielding fodders on the growth performance of growing Brown Bengal goats: The brown coloured goat known as hilly goats are reared for meat, skins and manure found in hilly regions of Bangladesh. They live mainly on naturally grown grasses, tree leaves, shrubs and bushes. However, pasture land of the hilly areas are decreasing gradually due to housing, rubber gardening, horticulture and other agricultural interventions. So, it is necessary to meet up the requirements by supplying with high yielding fodders. Thus, the study was undertaken to evaluate the feeding effect of HYV

fodders on the growth performance of hilly goats conducting a feeding trial to 16 growing kids feeding with four experimental diets at BLRI Regional Station, Naikhongchari, Bandarban. The goats fed with four different fodders (Napier-3, Napier-4, Ruzi and natural grass) had no significant differences for weight gain and FCR with an average gain of 48.63g/d. Thus, all of those fodders can equally be fed.

c. Study on the adaptability, biomass yield, nutritive value of HYV fodder cultivars under different saline condition in Southern districts of Bangladesh: Salinity intrusion due to climate change is an increasing problem in Bangladesh. The coastal zone of Bangladesh is already under the constant threat of salinity. In changing climate scenarios, fodder production may decrease and disease and mortality rates may rise, which may threaten the viability of the livestock production in future. To address the feeds and fodders problems in the Southern districts of Bangladesh, an agronomic study was conducted to find out the adaptability of HYV fodder cultivars in three different salinity locations; Bagherhat, Khulna and Stakhira. Five selected high yielding fodder cultivars (BLRI-Naper 1, 2, 3, German and Para) were cultivated among 15 innovative farmers having 5 farmers in each location. The results showed that significant variation in survivability was found among different cultivars, while BLRI-Napier 3 (hybrid) performed better than the other adapted cultivars.

Development of community based fodder production model and demonstration of fodder preservation technology in Haor areas of Bangladesh; a. Study on the effect of organic manures on biomass yield and nutritive values of BLRI Napier-3 and feeding effect in dairy cows: The north eastern parts of Bangladesh are known as haor characterized by water logging in most period of a year. The traditional livestock feeding system in haor areas is mainly based on rice straw and natural grasses supplemented with a little amount or without concentrates, although availability of natural grasses fluctuate seasonally, consequently acute shortage of feed supply during the dry season is prevailed. Keeping the problem in mind, a research was directed for the development of fodder production model with native or other suitable varieties of fodder in haor embankment to ensure the availability of green roughages throughout the year. A positive impact was found by increasing 37% daily milk production from existing 2.3 ltrs to latterly 3.2 ltrs. The study also revealed that the

biomass yield and nutrient content in BLRI Napier-3 fodder were higher applying cow dung manure than those of other organic manures and chemical fertilizer.

Development of salt tolerant Napier cultivar for coastal area through genetic engineering; a. Screening of salt tolerance and genetic divergence of

HYV fodders through hydroponic, tissues culture and RAPD markers: Napier grass is an important high yielding perennial fodder in Bangladesh, extensive research is necessary to develop moderate to high salinity tolerant fodder germplasm in the country with high biomass yield. To develop salt tolerant fodder germplasm by utilization of existing fodder resources at Bangladesh Livestock Research Institute, three different studies were conducted; i) Screening of BLRI Napier-1, 2, 3 and 4 for their salt tolerance level, ii) establishment of tissue culture technique for propagation of fodder crops and iii) study the genetic divergence among Napier cultivars. BLRI Napier-4 and BLRI Napier-3 showed better performance and highest biomass yield at upto 7 dSm^{-1} . Highest callus were induced when leaf roll and node of two Napier grass were cultured in MS medium supplemented with 5% coconut water and 2 & 4mg L⁻¹ 2, 4-D. The 10 primers (RAPD) used produced 115 bands. Of these, 111 were polymorphic (96.52%) and 4, monomorphic (3.48%). Genetic relationships among the genotypes at the average distance of 46.0 showed two major clusters (C_1 and C_2). BLRI Napier-1 and BLRI Napier-2 represent the major cluster C_1 while the major cluster C_2 included rest of all seven genotypes.

Development of cost effective crop residues based complete feed for Ruminates; a. Feeding effect of silage and soybean straw based total Mixed Ration (TMR) on the growth performances of growing calves: Crop residues and cereal by-products are the main constituents of ruminant diet in our country and their quality improvement by means of supplementation, treatment, transformation etc. is essentially important to compensate the nutritional problem of livestock. Thus, a study was undertaken to formulate, process and develop a total mixed ration (TMR) for fattening cattle by using locally available crop residues. For this purpose, five types of TMR were prepared based on different ratios of roughage and concentrate composed as 70:30, 60:40, 50:50, 40:60

and 30:70. A total of 30 growing bull calves were selected and equally divided into 5 groups for feeding five types of TMR having 6 bulls in each group. Although, the duration of the study as far conducted was not sufficient to draw a concrete conclusion, but the preliminary results showed an average daily weight gain of 0.892 kg, while 60:40 TMR performed better.

Outbreak and Distribution of Foot and Mouth Disease Virus Serotypes in Bangladesh (FMD & PPR Project): Foot and mouth disease (FMD) is one of the most important transboundary animal diseases that cause severe economic losses in Bangladesh. The present study was undertaken to investigate molecular epidemiology and genotyping of circulating FMDV serotypes in Bangladesh during January' 2011 to December' 2014. Out of 134 samples, 98 (73%) samples were found positive for FMD virus. Three different serotypes of FMD virus are currently prevalent in Bangladesh. Among the positive FMD virus isolates, serotype O and Asia 1 accounts for about 31% each followed by A (7%) and mixed infection (31%). Phylogenetic analysis of partial VP1 nucleotide sequences demonstrated that all BLRI/FMDV serotype O isolates were closely related to PanAsia strains, including those that originated from Bangladesh, Bhutan and India. For serotype A BLRI/127 isolates, it showed a close resemblance from isolates originated from India. FMDV type Asia 1 isolates were most closely related to FMDV isolates collected in Bangladesh during 2013.

Research Support

Review of project proposals for operational fund: Seven research projects under Research Grant were reviewed, out of which two were selected for funding, and project proposals of BLRI were reviewed in August 2014.

Coordination and Review meeting/workshop: As a member of Technical Committee and Expert Committee of BLRI, attended the committee meetings in August 2014 to review the progresses of on-going research projects and to evaluate & approve new project proposals of BLRI.

Monthly/Quarterly/Half yearly/Annual progress report/Project completion report evaluation (2014-15): Project Completion Report (PCR) of 9 SPGR sub-

projects were finalized and printed in different times (by PI's/Coordinator). Annual progress report of three Research Grant Projects under Livestock Division was evaluated.

Support to Avian Influenza/Bird Flue Prevention and Control Programs

As a member of the National Avian Influenza Technical Committee, suggestions and technical support was given throughout the year to prevent and control avian influenza (Bird flue).

Support to Scientists/Officers Recruitment and Research Of BLRI

- As a member of recruitment committee, support was given to recruit best scientist/officer and other staffs of BLRI.
- As a member of Technical Committee and Expert Committee, support was given to evaluate the progresses of different approved research projects and to evaluate & approve new project proposals of BLRI in August, 2014.
- Support was also given to other activities of BLRI.

Support to Policy Making Programs Related to Livestock

As a member of the expert committee, support was given directly in policy making programs related to livestock in MOFL, DLS, BLRI and other organizations throughout the year.

Technologies Developed

(From 2 coordinated SPGR Sub-projects and 1 Research Grant project)

- Multiplex Reverse Transcription-Polymerase Chain Reaction (RT-PCR) method for the identification of Respiratory Viral Diseases of poultry.
- An Optimized Polymerase Chain Reaction method for the identification of Infectious Laryngotracheitis Virus (ILTV).
- An Optimized Polymerase Chain Reaction method for the identification of Avian Leucosis Virus (ALV).
- An Optimized Polymerase Chain Reaction method for the identification of Mycoplasma sinoviae.
- An Optimized Polymerase Chain Reaction method for the identification of Escherichia coli (*E. coli*).
- A RT-PCR filter paper method for identification of PPR virus.
- Multiplex-PCR method to identify *B. anthracis* genome and its two types of plasmids.

Routine Functions

The division performed several other routine activities that included the followings:

- Annual progress evaluation of the research projects: Done in July to August, 2014;
- Preparation of annual report 2013-14: Done in April, 2015;
- Preparation of annual work plan 2014-15: Done in July 2014;
- Preparation of various other documents, etc.: Done throughout the year;
- Review of different documents and preparation of comments on them:
 - Draft Drugs Act-2014 of the Directorate of Drug Administration was reviewed and Comments were prepared on the draft act that has sent to the Directorate through the Ministry of Agriculture.
 - Comments and inputs were given on the "Krishi Gobeshona Sommanana Padak Nitimala 2014 (Draft)".
 - Comments and inputs were given on the "Preparation of Guidelines for increasing of Age Limit of NARS Scientists".
- Dissemination of technical knowledge as a resource speaker in seminars and training programs and rendering technical support to various organizations and agencies as an expert member and resource person:
 - Technical knowledge was disseminated as a resource person/expert in seminars/workshops/trainings/meetings organized by DLS/BLRI/MOFL/KGF/BARC,
 - To prevent and control avian influenza (Bird flue).
 - As a member of Expert Committee, to evaluate the progresses of different approved research projects and to approve new project proposals of BLRI in August 2014.
 - As an Expert member/Evaluator, to evaluate the completed project report of the BAS-USDA project (on livestock) in January, 2015.
 - As an Expert member/Evaluator, to evaluate the 1st Annual Progress Reports of one on-going research project (on Livestock), and the Draft Project Completion Report (PCR) of one completed project (on Livestock) of KGF in November, 2014.
 - As a resource person and organizer for two batches of a training course on Peste des Petits Ruminants (PPR), held at SAU, Sylhet on May, 2015. The course was funded under Revenue Budget of BARC.

- Providing technical support to other divisions of BARC: Done throughout the year;
- Providing technical support to different national and international organizations like BAU, CVASU, SAC, BAS, KGF, FAO, ILRI, etc.: Done throughout the year.
-Technical support was given as a member of National Steering Committee of the BAU part of the UNEP-GEF-ILRI Asia Project on “Development and Application of Decision Support Tools to Conserve and Sustainably Use Genetic Diversity in Indigenous Livestock and Wild Relatives” to operate the project activities in Bangladesh.
- As an Expert, two KGF and one BAS research projects were reviewed.
- Technical support/input was given to CVASU by joining 12th Annual Scientific Conference in CVASU, held on 25-26 April 2015.
- Monitoring and evaluation of the various projects:
-Two Research Grant projects under livestock were monitored during June 12-13, 2015.
-Seven Research Grant projects of other divisions (Crops-6, Fisheries-1) were also monitored at the same time.
- Participating different Agricultural (including Livestock) workshops/seminars/conference/meetings/trainings in BARC and elsewhere:
-Participated successfully different Agricultural (including Livestock) workshops/seminars/conference/meetings/trainings in BARC and elsewhere and provided technical inputs:
Workshops/seminars: 12 nos. (local)

Conference: 2 nos. (1 local-international)

Meetings: 15nos. (14 local)

Trainings: 3 nos. (local)

- Other unforeseen jobs (if any), relevant to the development of livestock that may emerge during the plan period:
-Attended ‘World Food Day’ programs, ‘World Milk Day’ programs, World Veterinary Day programs, etc.

FISHERIES

PROJECT DEVELOPMENT AND FINANCING

The Fisheries Division of BARC supported a number of research activities, workshops, seminars and training programs to enhance regular activities in the field of fisheries research and development during the period of July 2014-June 2015. The division funded, reviewed and monitored different research projects of Bangladesh Fisheries Research Institute (BFRI), Bangladesh Agricultural University (BAU), Sher-e-Bangla Agricultural University (SAU), Sylhet Agricultural University (SAU), and Haji M Danesh Science and Technology University during the reporting period.

The funding sources were revenue and SPGR, NATP Phase I. A total of 07 projects were funded during the reporting period. Among those, five projects were funded under the regular revenue budget and the remaining two projects were funded from SPGR, NATP Phase I.

SPGR Research Projects

Sl. #	Name of the project	Coordinator/ PI	Implementing organization
01	Gene Banking of Improved Broodstocks of Indian Major carps (Catla, Rohu and Mrigal) and Development of Breeding Technique of Three Threatened species (Mohashol, Bagair and Baim), BAU	Professor Dr. Md. Fazlul Awal Mollah	Bangladesh Agricultural University
02	Coordinated project on addressing climate change on fisheries sector through community based technology identification and adoption in the fragile aqua ecosystems of Bangladesh	Dr. KabirIkramulHaque, Professor Gazi M.A. Jalil& Dr. Azimuddin	BARC, SAU & BFRI

Core funded projects of BARC

Sl. #	Name of the project	Coordinator/ PI	Implementing organization
01	Study of reproductive endocrinology of mud eel Monopterus cuchia for artificial propagation	Dr. Harunur Rashid Professor, Department of Fisheries Management and Adjunct Faculty, Interdisciplinary for Food Security	Bangladesh Agricultural University (BAU)
02	Integration of fish culture with hydroponic agriculture system for alternate rural livelihoods	Dr. Md. Jahangir Alam Professor, Department of Fisheries Technology	BSMRAU, Salna, Gazipur
03	Fine tuning and demonstration of sustainable live food culture technology to produce low-cost prawn post larvae for coastal people	Dr. Md. Lokman Ali Assistant Professor and Chairman, Department of Aquaculture	PSTU, Dumki, Patuakhali
04	Development of artificial breeding techniques of Sperata aor	Dr. Mahbub Iqbal Associate Professor, Department of Fish Biology and Genetics, Faculty of Fisheries	Sylhet Agricultural University (SAU)
05	Seed production of endangered Cirrihinus reba: potential as a new aquaculture species an for its revival	Imran Parvez Associate Professor, Department of Fisheries Biology and Genetics	Hazi Mohammad Danesh Science and Technology University, Dinajpur

National policy guidelines (Policy and Governance issues)

- Contributed to finalize the "Fish Quarantine Act 2015" by the MoFL, GoB
- Prepared a comprehensive report on "Potential of commercial seaweed culture in Bangladesh" for the office of the Honorable Prime Minister's on request of the Ministry of Agriculture, GoB.

Governing body member of SAARC Agriculture Center

The Member Director (Fisheries) is a member of the Governing Body (GB) of the SAARC Agriculture Center (SAC). As the GB member, he has been participating in different planning and decision making activities of the SAC.

Technical committee member of BFRI

The Member Director (Fisheries) is a member of the Technical Committee, the highest authority of the Institute for approval of the research activities to be implemented under revenue and development fund. The meeting of the technical committee was held at BARC conference room. The research projects for the year 2014-2015 were discussed in the meeting. Among others, the senior Officials of the Ministry of Fisheries and Livestock, Planning Commission, IMED,

Professors from Universities, senior scientists of the institute were participated in the meeting.

Member of executive committee of Bangladesh Fisheries Research Forum (BFRF)

BFRF, as an independent organization of fisheries professionals including scientists, researchers, policy makers, private entrepreneurs, extension officials of universities, government and non-government organizations working for fisheries research and development since 2004. The scientist of the Division, as Joint Secretary of the executive committee, voluntarily contributed through identifying and scrutinizing the researchable issues, field and desk monitoring of the activities. In delivering the activities, scientists regularly maintaining liaison with the organization and participated in the technical, as well as executive committee meetings of BFRF.

During the reporting period BFRF has conducted a bi-annual conference at BARC auditorium. This conference was presided over by the Honorable State Minister, Ministry of Fisheries and Livestock. Also Honorable Secretary, Ministry of Fisheries and Livestock, senior Officials of the Ministry of Fisheries and Livestock, Planning Commission, Professors from Universities, senior scientists of BFRI, different

international fisheries research institutes, donor communities participated in the meeting.

Research and Financial Management and Coordination

The Division also played active role in coordinating among the institutes conducting fisheries research and finalizing the selection of annual research projects. Coordination among other NARS institutes, Universities and major extension agency, the Department of Fisheries through planning and participating in various activities related to fisheries research, development and extensions were intensified manifolds during the period. The Division regularly participated in the planning process of research projects of the BARC, BFRI, SPGR, NATP and KGF. A number of research projects were placed and discussed in various forums and finally approved for implementation during the period. The Division also assisted and guided the activities of Bangladesh Fisheries Research Forum (BFRF) and WorldFish Center in the planning process of their research activities.

Coordination (assisting in planning and implementing fisheries activities)

- Participated in DoF, WorldFish Centre, FAO, GIZ, DFID, different Universities and BFRF activities
- Contributed in formulation of DPP for GIZ and USAID.

Monitoring, reviewing and evaluation report of programs/activities of NARS institutes

Review, monitoring and evaluation of the ongoing research activities of BFRI are regularly carried out during the period. In addition, intensive field visit was carried out jointly with Officials and Scientist of DoF/BFRI in various locations of the country and monitored the progress of activities implemented under core research projects as well as projects funded under the SPGR, NATP Phase I those listed above. Supervision and monitoring were done during the period to ensure progress and timely completion of these projects. Almost all the projects were implemented and managed according to the set agenda and achieved notable results.

Transferable technology (Highlights of technology released during the reporting period)

During the period of 2014-2015, the BARC, under its research grants provision and SPGR NATP funding,

supported 09 research projects as listed above. Most of the research projects are ongoing and were initiated before 1-3 years ago and continued over the reporting period. During this period the project activities generated various information, however, none of these technologies have been released. It is anticipated that about 8-10 technologies will be ready for releasing.

Research Highlights of some of the important research projects are described below:

Gene banking of improved broodstocks of Indian Major Carps (catla, rohu and mrigal) and development of breeding technique of three threatened species (mohashol, bagair and baim): The objectives were to improve broodstock development through selective breeding and live and cryogenic gene banking of IMCs, and domestication and breeding technique development and conservation of three threatened species (mohashol, bagair and baim). Seeds from 9 sources (3 riverine sources viz. Halda, Padma & Jamuna and 6 hatcheries of three regions viz. Mymensingh, Comilla & Jessore) were stocked in separate ponds (2 dec. each) and their growth (length and weight) monitored for 6 months. Catla of Halda (190.55 ± 15.64 g) and Jamuna (191.79 ± 15.22 g) showed similar growth performance but significantly higher than Padma and hatchery sources. Growth of Haldarohu (119.85 ± 18.57 g) was significantly ($P < 0.05$) higher than Jamuna, Padma and hatchery sources. Haldamrigal showed significantly ($P < 0.05$) higher growth (121.07 ± 15.29 g) than Jamuna, Padma and hatchery sources. Genetic characterization of three species through allozyme electrophoresis and genetic characterization of rohu through microsatellite DNA marker have been completed. Riverine populations contained better genetic quality than hatchery populations. Cryopreservation protocols for rohu and mrigal spermatozoa were developed. Selective breeding of rohu and mrigal was completed.

Collection and domestication of threatened species (mohashol, bagair and baim) were done properly. Breeding seasons of mohashol and baim have been identified through histological observation. Four induced breeding trials of baim were conducted using different doses of carp pituitary gland (PG) extract. Breeding trials were given using doses ranging from 35-100 mg/kg body weight of female and 5-10 mg/kg body weight of male. In each trial, the first dose (30 %) and the second dose (70 %) for female were administered six hours apart. On the other hand, males in all treatments were treated once at the time of 2nd injection

of the female. PG dose of 35 & 40mg/kg body weight precipitated ovulation but best result was obtained from 40 mg/kg body weight in respect of ovulation of females, fertilization and hatching of eggs. Successive embryonic and larval development stages were also observed. A reasonable number of fry of baim have been produced which are being reared in the laboratory condition. This is the first successful induced breeding of this species in this region. Successful ovulation, fertilization were also achieved in case of bagair but hatching did not occur. Success in induced breeding of mohashol, it seems, will require some more time.

Coordinated Sub-project on addressing climate change on fisheries sector through community based technology identification and adoption in the fragile aqua ecosystems of Bangladesh: The objectives of the project were i) Identify climate change related major vulnerable issues of fishers' and small aquaculture communities, ii) Strengthen local community coping capacity through developing community based aquaculture/ fisheries technology management plan, iii) Pilot the identified technology options within the targeted communities, and iv) Develop guidelines for fisheries/ aquaculture management framework in context to climate change adaptation in similar communities.

Cage aquaculture: A total of 286 farmers produced table sized tilapia in their cages. Each of the farmers was provided with three cages from the project. The project also provided them quality fingerlings of tilapia and feed. The stocking density varied from 200, 250 and 300 fingerlings/m³. The cages were mostly set in canals and ponds of cluster villages. The average yield of each cage ranges from 26 kg to 40 kg per cycle. It was found that the growth performance was better when the stocking density was 250 fingerlings/m³.

Tilapia hapa breeding: A total of 139 farmers conducted tilapia hapa breeding in their ponds. The project supplied three sets of hapa for each individual farmer. These were 1 breeding hapa and 2 nursery hapa. The breeding hapa size was 7mX 4.5mX 1.5m. They have stocked 60 tilapia broods in each breeding hapa with a male female ratio of 1:3. Farmers were able to produce 25,000 to 1,00,000 tilapia fries from each hapa. Farmers got huge success by breeding tilapia in hapa. Even, two farmers (one in Gangachara & another one in Dimla) sold tilapia fries and fingerlings of Taka more than one lac each from their hapa breeding trials.

Community based fisheries management: Farmers of Gangachara managed a seasonal beel of 35 acres. There were 204 farmers in this group. They have stocked the beel with Indian and Chinese major carps, common carp and pangus. In the first year they have harvested 5 MT of fishes from their community managed beel. Besides, they have also harvested 2.5 MT of small indigenous fishes from the beel. In this year they are expecting more fishes from this beel.

Community based fish sanctuary management: One fish sanctuary was set in Ghagat river at Pakuriasharif, Gangachara. In this year Bhagna and Boal have spawned in the sanctuary. The fish sanctuary helps to improve bio-diversity of the water-body and thereby, fishermen can catch increased amount of fishes.

Chital poly culture in ponds: A total of 35 farmers of Amtali cultivated Chitala (feather back) fish in their ponds. The project supplied the fingerlings of chitala. The fish was fed mainly with life feed; mainly live mola and tilapia were released in the same pond. They are prolific breeders and thus they supply continuously feed for chitala. The average size of the chitala was 1.5 Kg in 10 months.

Vetki poly culture in ponds: A total of 45 farmers of Kalapara cultivated vetki (sea bass) fish in their ponds. This is a brackish water fish. The project supplied the fingerlings of vetki. The fish was fed mainly with life feed; mainly live mola and tilapia were released in the same pond. The average size of the vetki was 2 Kg in 10 months.

Koi and shingi mono culture: A total of 70 farmers of Dimla practiced Koi and shingi mono culture in their ponds. The project supplied fingerlings of koi and shingi. The stocking density of koi was 150 to 200 per decimal while the density of shingi was 250 to 350 fingerlings per decimal. Among koi and shingi, the shingi performed well and their market price is very high.

Over wintering of fingerlings: A total of 125 farmers conducted trial on over wintering of fingerlings. They have stocked mainly rui, catla, silver carp and mrigala. In the drought prone area over wintering of fingerlings created positive vibration. It is helping aquaculture farmers to stock larger size fingerlings at early season. On the other hand, farmers are making significant amount of profit from this technology.

Crab fattening: A total of 70 farmers conducted trial on crab fattening. They have used two systems for crab

fattening. In one system they stocked live water crab in bamboo made enclosures in ponds having water exchange facilities. While, some other farmers fattened their crabs in bamboo made small floating cages. They have fattened crabs for one month and fed them with tilapia or other trash fishes. Most of the farmers have completed 3 cycles of crab fattening and the cost benefit ratio of crab fattening is about 1: 2.2.

Rice-fish culture: A total of 125 farmers stocked with tilapia (10/decimal) and shorputi (10/decimal) in their rice fields during amon and boro season. They practiced Integrated Pest Management (IPM). In an average they have produced 4 Kg of fishes per decimal in their rice-fields. Rice-fish has appeared as a very good adaptation option to address the adverse impact of climate change. Even some farmers are using rice-field as the breeding ground of tilapia and common carps.

Planned Activities 2015-16

National policy guidelines (Policy and Governance issues)

- Climate change adaptation policy brief for fisheries sector
- National task force to identify constraints of fish production and marketing to develop policy guidelines

Research

- Core Research projects of BARC
- Core Research activities of BFRI
- New projects on fisheries sector will be formulated Training/Workshop/Human Resources Development
- Climate change adaptation of different fisheries technologies
- Community based fisheries management
- Seaweed culture
- Production of quality dry fish
- Prevention of fish diseases
- Community based fish sanctuary management
- Orientation training on fish hatchery acts
- Orientation training on fish quarantine acts
- Coordinated fisheries research: identification of research field and research team
- Monitoring/Evaluation/Coordination
- Core Research Activities (BFRI)
- BARC funded research project
- WorlFish/BFRF funded projects and activities
- NATP-2 funded projects and activities

Publications

- 3-4 scientific papers will be published from SPGR and core research projects regular activities
- Linkages/Coordination with National and International Organizations
- Preparation of Reports/ comments
- Annual Report
- Annual Work plan
- Monitoring/Evaluation/Progress report
- Technical Support to other Divisions/Agencies

NATURAL RESOURCES MANAGEMENT

Forestry, NRM

PROJECT IMPLEMENTATION

The Coordinated sub-project on improvement of agroforestry practices for better livelihood and environment - BARC component is aimed at coordinating and backstopping for improvement and monitoring the activities of six participating organizations *viz.* Bangladesh Forest Research Institute (BFRI), Institute of Forestry and Environmental Sciences, Chittagong University (IFESCU), Bangladesh Agricultural University (BAU), Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), Khulna University (KU) and Bangladesh Jute Research Institute (BJRI). The project has been implemented during the period from June 2011 to October 2014. The project started with an inception workshop on 8 September 2011 where the six participating organizations presented their work plan of activities. Monitoring of their activities has been done regularly. Coordination with the participating organizations has been done through different meetings, workshops, spot visits, e-mail correspondence, telephonic conversation, etc. A meeting was held at BARC with Deputy Director General of ICRAF where six participating organizations presented the activities of their SPGR sub projects. The Director General appreciated the initiative of livelihood improvement through agroforestry and opined that it was a time bound programme in the context of Bangladesh. Benchmark survey reports were received from all the sub-projects and feedbacks were given to all the organizations as and when required. A workshop was held at BARC on 17 April 2012 to critically analyze the benchmark survey reports. The participating organizations presented their respective reports. The research activities of IFESCU, BFRI, BAU, KU, BSMRAU and BJRI were properly

monitored in appropriate time to see the output/outcome/impact of all the participating organizations. Eleven training courses were organized at BARC on *Agroforestry technology* and *Agroforestry Practices in Bangladesh*. Eighty participants from different organizations participated in these program. They opined that such training would be more effective if could be organized for a longer time. The capacity of the participants due to the training enhanced from the baseline evaluation of 35% to 92% on completion of the training. Annual workshop on the progress of this sub-project was arranged on 24 June 2013 at BARC. PIU and Forestry unit jointly organized Project completion workshop on 27 May at BARC to examine the total activities and findings of the project with and finally a Project Completion Report (PCR) of the NATP-SPGR Coordinated Sub Project on Agroforestry Practices for Better Livelihood and Environment was published.

POLICY LEVEL CONTRIBUTION

Participated in the policy level meeting as Focal Point/Member in the following meeting:

- Advisory committee meeting and in the expert Committee meeting of Research programme of Bangladesh Forest research institute.
- National Disaster Management advisory committee.
- Chemistry committee meeting of BSTI.
- Technical committee meeting of BSTI.
- Technical committee meeting of MoEF.
- WARPO
- Department of Environment.
- Department of Forest.

Research Management/Financial Management and Coordination

Review of forestry research Program of BFRI

Research program of Bangladesh Forest Research Institute and other organizations involved in forestry and agroforestry research and development have been reviewed and necessary guidelines have been provided. It was observed that BFRI took about 70 research programs. BFRI was suggested to undertake research programme in future to cater to the needs of the end-users.

Research Review 2014-2015 and Program Planning Workshop 2015-2016 of Forestry and Agroforestry

Research Activities in Different NARS Institutes and Universities

A three days workshop on “Research Review 2014 and Program Planning Workshop 2015 of Forestry and Agroforestry Research Activities in Different NARS Institutes and Universities” was organized during 26-28 May 2015 at BARC conference room-1. The objectives of the workshop were to review the forestry research activities of 2014-2015, identify the problems, prospects, research activities and development of forestry in Bangladesh and future forestry research planning for 2015-2016 in Bangladesh. Sixty participants of NARS institute, different universities, Department of Agricultural Extension, Department of Forest and other organizations were participated in the workshop. Twenty research papers were presented in the workshop.

Monitoring, Evaluation, Field Visits

Review, monitoring and evaluation of on going research activities of Bangladesh Forest Research Institute are regularly carried out by the Forestry Wing, BARC. Dr. Mohammad Shahjahan, CSO (Forestry) visited BFRI on 5 June 2015 for forestry review



Dr. Mohammad Shahjahan, CSO (Forestry) visited research grant funded project in Sylhet

workshop. Forestry and agroforestry activities at Khulna University, Chittagong University, BFRI Chittagong, BAU, Mymensingh, BSMRAU, Gazipur, and BJRI. Monitored BARC Research Grand funded project in Sylhet region during 1-3 May, 2015.

Agricultural Engineering, NRM

POLICY LEVEL CONTRIBUTION

Different policy oriented comments were prepared for appropriate steps on emerging problems and prospective issues in the field of Agricultural Engineering and other related fields. All comments

were submitted to the Ministry of Agriculture as per their request through EC, BARC. Comments of the following issues were prepared and submitted:

- Declaration of Auto rice mills establishments as agro-based industry
- Bangladesh Water Supply and Sanitation Regulatory Commission Act 2014.
- Deletion of some commodity from 155 BSTI's mandatory standard specification list and inclusion of new commodity as per priority.
- 4. Bangladesh River Dredging Authority (BRDA) Act 2015.
- Investigation and Expansion of Groundwater Irrigation
- Engineering Research Council Act 2015.
- Publication on 'Plan of Action on Disaster and Climate Risk Management in Agriculture for Department of Agricultural Extension (DAE)' and "Main streaming Disaster Risk Reduction and Climate Change Adaptation in Agriculture-A Tool for Practical Use'
- Declaration of eco friendly modern techno based hybrid Hoffman Kiln brick field as industry.
- 9. Electricity Act 2015

Monitoring and Evaluation of Research Program of the NARS Institutes, SPGR- BARC Sub- projects and projects of other institute

1. Review nine SPGR sub-project's PCR namely i) Sustainable management of available water resources of unfavorable hill ecosystem ii) Improved potato storage facility for farm household iii) Development and adaptation of solar pump irrigation system under eco-friendly environment iv) Development and validation of USG applicator and rice transplanter v) Design, development, modification and introduction of self-propelled reaper and mini-power tiller to augment crop production vi) Utilization and management of sugar mills effluent water for irrigation purposes to increase crop production vii) Coordinated project on "Water management for enhancing crop production under changing climate: BRRI component viii) Coordinated project on "Water management for enhancing crop production under changing climate: BARI component ix) Coordinated project on "Water

management for enhancing crop production under changing climate: BINA component

2. Evaluated revised budget for extended period of SPGR funded project.

Worked as member in the different committee as mentioned below

1. Worked as member in the different committee as mentioned below:
 - a. Technical committee, Agricultural Mechanization Project of DAE, Dhaka.
 - b. Technical committee of Bio-gas, Infrastructure Development Company Limited (IDCOL), Dhaka.
 - c. Board of Management, National Science and Technology Museum (NSTM), Ministry of Science and Technology.
 - d. Governing Council of CSAM, United Nations Economic and Social Commission for Asia and the Pacific
 - e. BANCID Study and Publication Subcommittee.
 - f. Science and Technology Development Trustee Board, Ministry of Science and Technology.
2. Tour to Indonesia, China and Cambodia.
3. Attended meetings/seminar/ workshops organized by FAO, CEGIS, IWM, WARPO, BARI, BRRI, BCAS and BARC.
4. Review research paper and published follows research paper in different scientific journal, proceedings and newsletter
 - a. Trend of reference crop evapotranspiration under changing climate in North-West Hydrological Region of Bangladesh. Bangladesh J. Agril. Engg., The Institution of Engineers 24 (1 & 2):31-36.
 - b. Causes of variability of reference crop evapotranspiration under changing climate in north-west hydrological region of Bangladesh. J. Agril. Engg., The Institution of Engineers, 40/AE(2):7-14.
 - c. Determination of water requirement and water productivity of tobacco in different soils in Kushtia Region. J. Agril. Engg., The Institution of Engineers, 41/AE(1):15-21.
 - d. Impacts of Climate Change on Crop Coefficient and Reference Crop Evapotranspiration of Boro Rice in North-East Hydrological Region of

- Bangladesh. Proceedings of Fifth International Conference on Water and Flood Management (ICWFM-2015), 6-8 March, BRAC Center Inn, Dhaka, pp. 209-216.
- e. Impact of climate change on actual crop evapotranspiration of boro rice in Bangladesh. BANCID Yearly Newsletter. pp. 15-16.
 - 5. Published two Project Completion Report of the NATP-SPGR Coordinated Sub Project on Water Management for Enhancing Crop Production under Changing Climate
 - 6. Published Use of Farm Machinery and Efficient Irrigation System Management Training Manual 2015
 - 7. Attended training programme organized by BARC.
 - 8. Worked as member in the different committee of BARC.
 - 9. Worked as a co-supervisor in MS research in Irrigation and Water Management Department of BAU, Mymensingh and BSMRAU, Gazipur.

Linkage

Maintained strong Linkage with the engineering professional bodies in home and abroad like CIMMYT, IRRI, IEB, BWDB, CSAM (Before it was UNAPCAEM), WARPO, BSTI, NGOs (IDE, BWP /GWP), FAO, BANCID and Universities etc.

Brief Highlights of R & D of the concerned NARS Institutes

1.1 Farm Machinery

Adoption of power tiller operated seeder (PTOS) in rice-wheat cropping system: Power tiller operated seeder (PTOS) is demonstrated in different locations in the farmer's field of Dinajpur, Thakurgaon, and Rajshahi area 2014-15. The density of rice residue was 0.8-1.4 t/ha. Minimum tillage by PTOS saved irrigation water for wheat, maize and rice 14.9%, 5% and 30%, respectively compare to traditional irrigation method of crop cultivation. It is environment friendly, minimum disturbance soil and saved diesel fuel 94 lit./ha/yr. Wheat yield was 25.5%

higher than conventional method. Effective field capacity was 0.15ha/hr. Cost of wheat seeding was Tk. 1950/ha which was 65.8% less than conventional method (Tk.5695.0/ha). PTOS covers about 4003 ha land in Rajshahi and Dinajpur area. Long term on station trial (6 years), wheat yield in minimum tillage by PTOS shows higher than conventional planting system in rice-wheat-mungbean crop rotation maintaining 30% crop residue. No yield reduction trend observed over the time compare to conventional method. There are about 980 seeders now in the country which cover about 29000 ha land.

Fine tuning of power tiller operated bed planter: A power tiller operated bed planter has been improved and fine-tuned with locally available materials in Wheat Research Centre, BARI Rajshahi and adaptive trials were conducted in the farmers' field of Rajshahi and Dinajpur area during 2014-15. Performance of the bed planter was tested for wheat, maize, mungbean and rice cultivation. The uniformity of maize seed spacing was 86-95%. The density of rice and wheat residue were 1.8 t/ha and 1.6t/ha in the tested plot, respectively when seeding on permanent bed. After initially forming the bed, an additional advantage was that reshaped bed can be used for next crop without any further tillage operation keeping it permanent. Fresh bed saved 21.5% and permanent bed saved 34.1% irrigation water over conventional flood method of irrigation with less number of labour involvements. Water logging problem can be avoided introducing bed planting system, especially in rainy season crops. Bed planting allows earthing up, so no need subsequent earthing up in maize cultivation. Bed planting saved 44% tillage cost compare to conventional method. Maize planting cost in new bed and permanent bed was 63.0% and 72.5% less than conventional seeding method. Yield advantage was 33% over conventional method. Long term on station trial (6 years), wheat yield under bed planting shows higher than conventional planting system in rice-wheat-mungbean crop rotation maintaining 30% crop residue. Net return for wheat cultivation in bed planting is 1.2 times than conventional system. The bed planter is now

using as custom hire basis in the farmers field. There are about 6325 ha lands under bed planting system.

On farm validation of zero tillage planter for up land crops production: A low cost and robust power tiller driven (12Hp) zero-till planter has been improved with inclined plate seed meter assembly in Wheat Research Centre, BARI, Rajshahi, Bangladesh with locally available materials for seeding different kinds of seeds. The validation trials of zero-till planter with weed control management were conducted in the farmer's field in Rajshahi areas for wheat, maize, and pulses establishment during the year 2011-2014. The planter can pull 4 tynes in soft and medium hard soil but 3 tynes for hard soil. The planter was capable to apply seed and fertilizer in an opening slit of width 30mm and depth 60mm. The planting depth, row spacing and seed rate can be adjusted according to standard practices. Depending on the level of weed situation, round up herbicide was applied 2 days before planting to kill the existing weeds. No till crops show less lodging tendency compare to conventional planted crops. Zero-till farmers saved plant establishment cost 50-65%, and minimizing the average turn around time 7-9 days between the two crops. The effective area coverage and planting cost by the seeder was 0.12ha/hr and Tk.1900.0/ha, respectively.

Performance evaluation of a tractor mounted vegetable transplanter: A tractor mounted vegetable transplanter performance was tested in experiment field of Farm Machinery and Postharvest Process Engineering Division of Bangladesh Agricultural Research Institute, Gazipur during 2014-15. It was used for transplanting seedling of tomato and cauliflower. The average field capacity of the machine was 0.091 ha/h. It has provision for arrangement of depth of placement for different seedling. The average depths of placement were found 4.15 cm & 2.95 cm for tomato and cauliflower respectively. The missing and damage rate was 3%. The treatments were T₁- transplanting by tractor operated vegetable transplanter, T₂- transplanting by hand at transplanter spacing (row to row 60 cm

and plant to plant 40 cm), T₃- transplanting by hand at BARI recommended spacing (row to row 60 cm and plant to plant 45 cm). There were no significant difference of yields of tomato and cauliflower among the treatments.

Evaluation and extension of power tiller operated potato planter in the farmer's field: Field demonstrations were conducted at on station and the farmers field of Puthia, Paba Rajshahi. Performance of the planter was evaluated in the farmer's fields to determine the effect of forward speed and seed sizes on the uniformity of spacing and seed missing during 2014-15. Four speeds and three seed sizes were varied to evaluate the planter. Uniformity of spacing varied with the increase of operational speed. It was found that forward speed of 2.4 km/h is the best in respect of uniformity of spacing and missing seeds. Seed sizes of 35mm were found the best in respect of uniformity of spacing (94%) at the speed of 2.4 km/h. The average effective field capacity of cup type planters were 0.10 ha/hr and missing seed was 3%. Potato planter requires 4 man-days/ha compare to 67 man-days/ha in conventional manual planting method. Potato planting cost were Tk.4804/ha. On the other hand, using whole tuber and cut piece seed, manually potato planting cost was Tk.14,740/ha and Tk.16940/ha. Labour requirement for whole tuber seed planting in case of planter and conventional method were 4 man days and 67 man days, respectively. Potato planter can save labour requirement of 63 man-days/ha and planting cost Tk9936/ha which was equivalent to 94% and 67% saving of labour and planting cost, respectively compare to conventional manual potato planting method.

Design and development of a power tiller operated multi-row weeder for wheat: Improvement of the weeder is going on and three major modifications were done during 2014-15. Modification of shovel blades, addition of cutting disks and narrow size (65 mm) cage wheel impart some improvement in weeder maneuverability and performance. The weeder was compared with other available weeders namely BARI dryland weeder and hand spade for wheat to find its

performance. The power tiller operated multi-row weeder obtained the higher field capacity (0.14 ha/h) was found. In spite of higher percentage plant damage (4.58%) shown by the power weeder but it has not significant effect on crop establishment. Whereas the cost of weeding was found the lowest (930 Tk/ha) compared to other weeding tools.

Comparative performance evaluation of manual injector type usg applicator: Different type of Urea Super Granule (USG) applicators performance were tested in three locations at FMPE Research field, RARS Jamalpur, Farmer field, Gazipur. The treatments were T_1 = Application of USG by the BRRI applicator, T_2 = Application of USG by the BARI applicator, T_3 = Application of USG by single row IFDC applicator, T_4 = Application of USG push type IFDC applicator, T_5 = Application of USG by hand and T_6 = Prilled urea. All the treatments were replicated thrice with RCB design. The applicators were tested for BRRI dhan 28 during 2014-15. The average field capacity of the BRRI, BARI, IFDC single row and IFDC injector type USG applicators were 0.120, 0.124, 0.0456 and 0.040 ha/h respectively. In case of yield, there was no significant difference among the treatment, but comparatively higher yield in BARI double row and IFDC injector type USG applicators. The payback period of the BRRI, BARI and IFDC single row USG applicators were 5.23, 3.85 and 35.77 days.

Development of a power tiller operated potato harvester: A power tiller driven potato harvester has been developed with locally available materials in Regional Wheat Research Centre, BARI Rajshahi 2014-15. It is a semi automatic digging machine. The potato harvester consist of i) digging blade ii) conveyer flat chain iii) Guide plate iv) Power transmission arrangement. The dimension of the harvester is 900 x 850 mm x950 mm. There are two model of potato harvester, (i) Power take from fly wheel belt pulley to rotate the conveyor chain (ii) power take from gear box of power tiller and rotate the conveyor chain. It

covers daily average 8 bigha land depend on operator skillness. Potato harvester requires labour 21 per ha only instead of 60 labours per ha in traditional manual method. Harvesting cost by potato harvester is Tk. 8,357 per ha but manually harvesting cost is Tk.17,100 per ha, respectively. Potato harvester saved 51% cost and 65% labour. Moreover, there are no potatoes remain inside the soil. Potato damage percentage is only 1.2 1%.

Modification and performance evaluation of a mango harvester: A mango harvester was designed and fabricated in Farm Machinery and Postharvest Process Engineering Divisional workshop, BARI, Gazipur during 2014-15 to minimize postharvest loss due to harvesting. The performance of modified harvester was compared with existing BARI mango harvester. The weight of modified harvester is 4.1kg whereas existing harvester is 1.5kg. The mango was harvested from different heighited mango trees in different location of BARI campus. The highest capacity of modified and existing harvester was found 76.15 and 72.48 kg/hr when number of mangoes per kg was 6.5% of mango with pedicel length below 1-1.5 cm was found by modified harvester which is satisfactory whereas it was 18% for existing harvester.

Development of a mechanical vegetable washing machine: A study was conducted in Farm Machinery and Postharvest Process Engineering Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur. A base line survey was conducted on vegetable production, sorting, washing, packaging mainly of carrot, red amaranth and brinjal from three vegetable growing districts such as Narsinghdi, Bogra, Jessore, and one major carrot growing area Pabna for developing a mechanical vegetable washing machine. Two upazila from each district were selected considering the primary and secondary markets. The respondents for primary data collection were 71 farmers, 30 pickers and 20 retailers. Washing of vegetables mainly practiced by farmers and pickers and it varied from location to location. Sorting and grading were done either farmers or pickers. In all locations, red amaranth and root crops (carrots and radish) are washed by

farmers to get better price. A vegetable washing machine was designed based on the base line information. The capacity of the machine would be 1.0-1.5 ton/h depending on the type of vegetables.

Modification of a hot water treatment plant for fruits: A simple and less electricity requirement hot water treatment plant was designed and fabrication in the Farm Machinery and Postharvest Process Engineering Division of Bangladesh Agricultural Research Institute, Joydebpur, Gazipur in 2015. An electric motor of 0.38 kW used for rotation of conveyor roller and stirrer and two electric immersion heaters of 2 kW each used instead of 10 heaters of 2 kW capacity of existing one for instantly recover the heat that absorbed by the immersion treated fruits. The plant was made of stainless steel sheet (SS), SS roller, SS shaft, SS sprockets, chains and SS angle bar etc instead of MS materials of existing one. The chula was made of MS rod, MS angle bar and MS sheet for eating water initially using locally available biomass. A 15 kg of tree wood was required for heating of 400 litres water in the plant for treating fruits within 50 minutes. The capacity and price of the plant is 448 kg/h for mango and Tk 1,20,000 (\$1600). Treatment cost by the plant is 0.68 Tk/kg.

Improvement of existing BARI maize sheller for shelling unhusked maize cobs: An improved BARI maize sheller was designed and fabricated in Farm Machinery and Postharvest Process Engineering Divisional workshop, BARI, Gazipur during 2014-15. This machine has two parts. Peeling is done in upper part and husked cobs are delivered to lower portion for shelling. Two rubber and two spiral rollers were used for peeling of cobs. Axis height of each pair of peeling rollers was different. The moisture content of the maize cobs with skin was 19%. The peeling capacity of the manual and power peeling was 83.63 and 330 kg/hr respectively. The average engine and machine speed were 1247 and 360 rpm respectively.

Performance evaluation of lithium ion battery for operation of BARI developed small powered machinery: BARI Solar Pump and BARI Winnower were operated and tested with lithium

ion battery at Farm Machinery and Postharvest Process Engineering Division of BARI, Gazipur during 2014-2015. One horse power solar pump and half horse power Winnower were operated with five kilowatt lithium ion battery. The battery was charged by 900 W_p capacity solar panels. Total time required for full battery charging was 10 hours. Total discharging time of lithium ion battery for operation of solar pump and winnower were three hours 20 minutes and six hours, respectively. The average discharge of solar pump at the suction heads of 1.5 to 6.5 m was 187 L/min. During operation of winnower by lithium ion battery, the speed of motor as well as the machine remained almost constant although the voltage and current reduced sharply with the operation time. Therefore, BARI Solar Pump and BARI Winnower operated by lithium ion battery were found to be technically suitable during off sunshine period.

Design and development of power transmission system of a self-propelled power unit for multiple use: A gear box of self-propelled power unit was developed in BRRI research workshop. Power transmission unit of the reaper was tested in paddy and wheat field and its' performance of reaper was found satisfactory. This gear box is functionally well but it is little bit heavy. So, it is necessary to design a new gearbox with compact size and reduced weight. In this machine for easy power transmission, a gearbox with mechanism of two forward and a backward speed have been designed with the help of AutoCAD tools and developed at BRRI Research Workshop.

Design and development of a power tiller operated grain cleaner: Power tiller operated grain cleaner has been developed at BRRI research workshop and tested at BRRI threshing yard. Two flat bar of 68 cm length were taken and both end of bars were made curved in same direction. Then those were fixed with a pulley as cross blade and fitted rigidly with the flywheel of a power tiller engine. Then a cover was made as safety measures to protect the operators/users from any accident. The cover was made with MS wire (1/8th) and it was tightly fitted with chassis and oil tank by nut

bolts. Before operation, it should be fixed with the engine flywheel well. Air flow rate was found 7 m/s at a linear distance of 1 m and it is decreased to 3 m/s at 5 m from center of flywheel. 1200-1600 kg paddy can be cleaned in an hour. Male or female can use this easily. Fuel consumption is 700-800 ml/hr.

Determination of tilling efficiency of power tiller at selected areas of Bangladesh:

Experiments were conducted at Jhenaidah district in Boro and Aman seasons 2014 to determine paddy yield as influenced by different tillage depths. There were three tillage depths such as: 4-5 inch, 5-6 inch and 6-7 inch and these were maintained by a power tiller. Tillage depths affected both the yield of BRRI dhan28 in Boro season 2014 and BRRI dhan56 in Aman season 2014. The highest grain yield of BRRI dhan28 was found 7.50 t/ha in the tillage depth up to 6-7 inch and the lowest yield was found 6.88 t/ha in the tillage depth up to 4-5 inch in Boro season 2014. On the other hand, in Aman season 2014, the highest grain yield of BRRI dhan56 was found 5.40 t/ha in 6-7 inch tillage depth and the lowest yield was found 4.40 t/ha in 4-5 inch tillage depth. Higher tillage depth might have favoured the roots to proliferate down into the deeper layers of the soil profile to extract more nutrients and moisture that has led to yield of paddy in both seasons.

Feasibility study of solar energy use in agricultural machinery: The study was conducted preliminary on solar energy use in BRRI winnower. To operate BRRI winnower, Photovoltaic system consists of 200 W solar panel, energy storage, converter, charge controller and Balance-Of-System (BOS) components were installed at BRRI automobile workshop. The battery storage accompanied by a charge controller in order to prevent the batteries from reaching either an overcharged or over discharged condition was used. 0.5 hp 48 Volt DC motor was used in BRRI winnower to clean paddy. A connector and an accelerator were used to start and control the DC motor. Stored solar energy was used in winnowing paddy at BRRI threshing yard. In other

time this energy used as illumination of four bulbs of each 15 W at BRRI automobile workshop.

Development of BRRI Panicle Thresher: The objectives of this experiment to design and develop a panicle thresher, to add cleaning and bagging facility and to observe the performance of developed panicle thresher. Two units of BRRI panicle threshers were fabricated incorporating bagging facility. Hood was added on the top of the thresher to avoid spilled grain. Four rubber wheels were added for ease of transportation. The threshing drum length was adjusted for two operators. Message of this experiment was transportation, cleaning and bagging facilities were added in the BRRI panicle thresher. Moreover, straw remain unchanged after threshing. This machine can be used as an alternative to winnower.

Design and development of power operated hand reaper: The objectives of this experiment was to harvest cereal crops and to evaluate the performance in comparison with sickle harvesting. Pre-requisite of the machine as crop should be standing, Straw should be greenish (80~90% maturity of paddy), Reaping paddy should be threshed with close drum thresher without binding, Cutting blade metal should be high speed carbonated and Guide is utmost need for line falling of harvested paddy. Results of this experiment: the performance was satisfactory and dependent on skill operator, the field capacity of the hand reaper was 16~22 decimal/h and fuel capacity 0.8~1.0 l/h and the 25cm diameter cutting blade with 4 no. of teeth/cm showed the best result.

Performance evaluation of different types of reaper: The objectives of this experiment was to compare the performance of BRRI PT mounted reaper with Chinese and Korean reaper, identify the field constrained of the reaper and analyze the break-even point. RCB design was applied with three replications. Treatments were T_1 = Self-propelled Korean reaper (KR), T_2 = China reaper (CR), T_3 = BRRI power tiller operated reaper (BR) and T_4 = Manual harvesting (MH). Results indicated that all three types of reaper are

suitable in Bangladesh condition with some limitation. Reaper performs better with soil moisture in the range of 20-30% and standing crop. It helps to reduce harvesting time, cost of harvesting and human drudgery of harvesting operation. Actual field capacity and field efficiency increased with the increasing of land size and operator's skill.

Design of a Single row conical weeder: The objectives of this experiment was to develop a weeder and to design and drawing of a single row conical weeder. The design was completed with the help of Auto CAD engineering tools. Design consideration easy of weeding, easy and simple of operation and maintenance, distance between row to row, locally available materials and one person operation system. Design and drawing of the BRRI conical weeder has been completed. The designed BRRI conical weeder is going on under process of fabrication in the FMPHT divisional workshop.

Effect of growing media on quality seedling raised for mechanical transplanting: The objectives of this experiment were to raise seedling on different growing media and assess seedling strength and rolling quality of the seedling material. Aman season showed better performance irrespective of soil types and organic fertilizer with the rate of mixture 0 to 30% except mustard cake. Rolling quality decreased with the increased of mixing rate of organic fertilizer for both types of soil during Boro season. Cow-dung, rice bran, organic fertilizer, poultry liter and vermicompost showed better performance with both types of soil with the mixing rate of 0 to 20, 30 to 40, 0 to 20%, 0 to 10 and 0 to 20% respectively. In addition, clay loam soil gave good rolling quality of the seedling mat irrespective of organic fertilizer and rate of mixture. Rolling quality varied among the organic fertilizers with both types of soil in the order of rice bran>cow-dung>vermicompost>organic fertilizer>poultry litter>mustard cake. Seedling strength varied with the individual and interaction effect of soil, organic fertilizer and rate of mixture. Boro season produced more seedling strength because of stunted seedling for cold spell that produced more dry matter per unit length. On the

other hand, seedling produced less dry matter with the seedling height for excessive growth during Aman season.

Optimization of seedling density as influenced by seed rate for mechanical transplanting: The objectives of this experiment were to identify seed rate for optimum seedling density of different variety and identify suitable transplanting option for different density. Results indicated that no. of seedling/area as affected under different seed rates and varieties. Percentages of the seedlings emerged from the sown seeds decreased with increasing seed rate irrespective of the variety. As seedling adjustment options was changed from 1 to 9, the number of trays per hectare increased from 185 to 339 and seedling strength decreased with the increased of seed rate. Average number of plants per stock increased and percentage of missing hills decreased with increasing both seed rate and seedling adjustment options of the rice transplanter irrespective of variety. Seedlings per stroke and percentage of missing hills were similar among seed types- Based on missing hills and number of seedling per hills under different seedling adjustment options, 130g of seed/tray for bold grain; 140 g/tray for medium and slender grain and and 120 g/tray for extra long and slender paddy was found suitable for the studied transplanter.

Fuel consumption and seedling tray requirement in commercial mechanical transplanting: The objectives of this experiment were to reduce the tray requirement of mechanical transplanter, provide service to the farmers for mechanized transplanting and identify the constraints of commercial service of mechanical transplanting. Results indicated that 25% trays were saved after providing technical support due to synchronize the seedling density in tray, plant spacing setting, water height and depth of puddled field. Tray requirement in each plot can be reduced by adjusting plant to plant space and seedling density setting.

Evaluation of TEGRA mechanical transplanting over traditional method of rice transplanting: The objectives of this experiment

were to evaluate the Tegra method over traditional method of transplanting and analyse benefit cost ratio of Tegra method. Results indicated that Fuel consumption in walking type mechanical transplanter in both season ranged from 4.4 to 4.6 L/ha. Plant to plant spacing was set 15 and 17 cm. Plant spacing varied depending on the puddled condition and soil type. Missing/floating hill observed insignificant in mechanically transplanted field. Tillering ability was higher in TP and grain yield was 14-23% higher in TP than FP. Tegra practices is more profitable in Boro season than Aman season.

Development of a head feed power thresher: The objectives of this experiment were to develop a head feed thresher, evaluate the threshers performance and compare the performance with BRRI existing threshers. Threshing capacity of head feed thresher was found 300 kg/h with cleaning and intact of straw facility. This machine can be used both in head feed and whole feed purpose.

Performance evaluation of BRRI prilled urea applicator in BRRI farm, Gazipur: The objective of this experiment was to evaluate the performance of the BRRI prilled urea applicator. Treatments were T_1 = USG application by applicator (2.7 g/4 hills), T_2 = Hand broad casting of prilled urea (recommended rate), T_3 = Prilled urea application by applicator (70% of total urea in broad casting) and T_4 = Control (-N₂). 6-8 cm deep placement of prilled urea by BRRI prilled urea applicator saved 30% urea and gave the highest yield. Farmer can use BRRI prilled urea applicator for saving urea.

Field performance evaluation of a combine harvester: The objectives of this experiment were to find out the actual field capacity of combine harvester and compare the harvesting cost between manual and combine harvester. Fuel consumption obtained 40 liter per hectare. Fuel consumption of the combine harvester depends on plot size and shape, crop density, lodged crop etc. For densely crop area machine should be operated in slow speed. Cutting of lodged crop takes more time than standing crop. Small plot required more turning

time. Hence fuel consumption will be increased. Field capacity of combine harvester for large field was 0.23 ha/h. Field capacity of big land increased 64% compared to small land.

Improvement of air-blow type engelberg huller: The objectives of this experiment were to design and fabricate air blowing type rice mill for commercial use and test & evaluation of modified air blowing type rice mill. Existing small engleberg huller rice mill was modified into air blow type rice mill for commercial use. Major change in modified air blow type mill were motor power increased from 4 kw to 15 kW, 8 no. huller, and 60 thw screen used then to 75 thw, blower pulley changed to 250mm to 279.4mm for more suction, blower fan revolution increased 3788-4462 rpm, different pieces of weight were added to control delivery and no need to press by finger, new screen attachment in the delivery point, blower attachment was changed and cyclone separator was added to collect the husk, bran and small broken mixture. Results concluded that modified air blowing type (one-pass) mill saves time and produce quality of milled rice than traditional engelburg rice mills. Modified air blowing types mill capacity was found 250 to 300 kg/hr which is 2 to 3 times more capacity than small air blowing rice mill. Farmers and millers both will be benefited by getting extra 1.0% rice than traditional engelberg huller.

Field trial and demonstration of promising farm machinery and technology to the LFS farmers: The objectives of this experiment were to create awareness among the LFS farmers to use farm machinery in their farming operation and develop skilled operator on agricultural machinery at farm levels. Machinery and technology demonstrated as seedling raising technique (both mat type and tray type), mechanical rice transplanter, BRRI USG applicator, BRRI Prilled Urea Applicator, BRRI power weeder and BRRI weeder. Results indicated that the yield of mechanically transplanted rice was higher than manual transplanted rice. BRRI Prilled urea application by applicator and USG application by USG applicator produced higher grain yield than

hand broadcasting of urea application. Time of weeding operation and human drudgery was also less in mechanical weeding compared to manual weeding.

Juice Extraction from Sugar beet by Pressing Method: The sugar beet is next only to sugarcane as the foremost source of the world's sugar. Tropical sugar beet can be a very important sugar crop beside sugarcane to produce sugar, goor etc in Bangladesh. Conventional juice extraction process from sugar beet is very complex. A slicer machine is required to slice the beet as well as a diffuser to extract juice from beets. Most of the farmers of Bangladesh are poor and they don't agree to bear this costly process. Besides this, Juice extraction from sugar beet by pressing method is a very easy and less costly process. Fresh sugar beet was freezed and thawed to disrupt the internal cell structure of the beets. Then thawed beet was pressed by a pressure device to extract juice. Sixty percent of beet weight was extracted as juice from the beets and the brix percent was 17. Sucrose content was 14 percent and the reducing sugar was 0.13 percent.

Design and development of sugar beet slicer: Sugar is produced from sugar beet where raw juice is collected through diffusion process. Diffuser for diffusion and slicer to make slice the beet is the main mechanical means of beet processing. This technology is new in our country. So an attempt was made to design and develop a Slicer. A slicer was designed and developed as per design during 2014-2015 cropping season. 2 hp electric motor, bevel gear and belt pulley connect each other to transmit power to cutting bled. There are two sets of cutting unit in a circular disk made by stainless steel. Each of the unit consisted of two types of blades, of them one cut horizontally and the other vertically. Advantages are i. Capacity of the machine is very high ii. One man can operate it easily iii. The machine is portable and can be shifted easily from one place to another iv. Manufacturing cost is very low v. The machine can be manufactured by locally available

materials. Capacity was 1000 Kg/h and The price is Tk. 60,000 (including motor).

1.2 Irrigation and Water Management

Effect of deficit irrigation to wheat on raised bed: The experiment was conducted during Rabi season of 2014-15 at the research field of the Regional Agricultural Research station, BARI, Ishwardi, Pabna to find out the water requirements of wheat on raised bed and to relate soil moisture content behavior with the changing climatic parameters. The result showed that a significant effect of irrigation treatments on plant height, plant per m², and grain per spike, 1000 grain weight and grain yield. The highest grain yield (3.82 t/ha) was obtained from treatment irrigated at (17-21) DAS, (55-60) DAS and (75-80) DAS over irrigation at 30%, 50% and 60% SMD level with used to 307mm, 236mm, 220 mm , 250 mm of seasonal water , respectively. The second highest yield (3.55 t/ha) was obtained at 30% SMD level and closest to T₁(Three irrigations at (17-21) DAS). At water stress condition, wheat may be also cultivated on raised bed system with 2 irrigations (at 48, 83 DAS) sacrificing minimum grain yield.

Effect of irrigation and mulch on the yield of maize in coastal areas: This study was conducted at the farmer's field located at Chandpasa union close to Babugong Upazilla of Barisal District to determine the experimental evidence of the effect of irrigation management and straw mulch on the yield of maize. The experiment consisted of two factors: irrigation and mulch. The irrigation and mulch treatments were: Main plot: Irrigation (4): I₁: Farmer practice, I₂: One irrigation at 4 leaf stage, I₃: Two irrigations 4 leaf stage and 8-10 leaf stage, I₄: Three irrigations at 4 leaf stage, 8-10 and leaf stage, tasseling stage, Subplot: Mulch (4), M₁:(No mulch), M₂: (mulch with 1 cm), M₃: (mulch with 2 cm), M₄: (mulch with 3 cm). The variety of test crop was BARI hybrid Maize-9. The treatment I₃ produced the highest grain yield of 6.68 t/ha and I₁ (farmer practice) produced the lowest yield of 6.00 t/ha. The treatment M₃ produced the highest grain yield of 6.47 t/ha and M₁ (no mulch) produced the lowest yield of 6.19 t/ha. The highest grain yield of 7.45 t/ha was

obtained for I₃M₃ and the lowest of 4.79 t/ha was obtained for I₄M₄. The highest water use efficiency for grain production, WUE (37.44 kg ha/cm), was obtained at I₁ and the lowest (13.94 kg/ha/cm) was obtained at I₄. The highest water use efficiency for grain production, WUE (35.76 kg/ha/cm), was obtained at M₄ and the lowest (29.43 kg/ ha/cm) was obtained at M₁. The highest BCR (1.44) was obtained from I₃M₃.

Estimation of crop coefficient values of sunflower by Lysimeter study: The experiment was conducted on sunflower (variety BARI Surjomukhi-2) crop during the month of mid-November to mid-March in a lysimeter (dimension:1 m X 1 m X 1 m size) to measure the daily evapotranspiration of the crop (ETc) and crop coefficient (Kc) value from 2014 to 2015 at Irrigation and Water Management Division, Bangladesh Agricultural Research Institute, Gazipur. The study was examined by applying four types of irrigation at an interval of 10, 15, 20, and 25 with allowing drainage within and adjacent of four lysimeter tank. Irrigation at 15 days interval produced highest yield and was consider suitable for estimating ETc and Kc. The kc values of sunflower at initial, development, mid-season and late season were found to be 0.70, 1.49, 1.95, and 0.50. These values were found higher than the value recommended by FAO although both followed Penman-Monteith equation for estimating ET₀.

Effect of deficit irrigation on growth and yield of sunflower: This experiment was conducted at the research field of Irrigation and Water Management Division, BARI, Gazipur, and Agricultural Research Station, Benarpota, Satkhira during the Rabi season of 2013-2014 and 2014-2015 with BARI Surjomukhi-2. It was found that about 50 and 30% water was saved to produce 2.18 and 2.52tha⁻¹ yield by applying DI_{60%} up to FC at vegetative and pre-flowering stage in Gazipur and Satkhira which had increased WP and economics. It was also observed that pre-flowering stage was the critical stage to deficit irrigation. From this study it can be recommended that cultivation of BARI Surjomukhi-2 is suitable in saline and non-saline region in terms of yield and oil content at

DI_{60%} at vegetative and pre-flowering stage compared to FI as water is scarce in both the location in terms of quality and quantity.

Effect of irrigation on the yield and quality of litchi: The study was conducted at RARS, Hathazari, Chittagong and RARS, Ishwardi, Pabna during 2013-2014 and 2014-2015 to determine the effect of irrigation on yield and quality of litchi as well as to identify the critical growth stages to irrigation. In Hathazari, yield and yield contributing characters varied significantly among the treatments. The average litchi yield of two years ranged from 17.50 kg/plant to as high as 45.40 kg/plant. The lowest average yield (17.50 kg/plant) was obtained from the T₁ (Non- irrigated tree) and the highest average yield 45.40 kg/plant) was found from T₄ (irrigated at flowering and fruit setting stages). The highest amount of irrigation water (290 mm) was used by the highest yielded treatment (T₄) at 2014-2015, which was 349mm in 2013-2014. The economic return/tree was also the highest (Tk. 3861) from the irrigated trees (T₄) in 2014-2015. In Ishwardi, the average litchi yield of two years ranged from 28.49 kg/plant to as high as 52.77 kg/plant. The lowest average yield (28.49 kg/plant) was obtained from the T₁ (Non- irrigated tree) and the highest average yield (52.77 kg/plant) was found from T₄ (irrigated at flowering and fruit setting stages). The highest amount of irrigation water (267 mm) was used by the highest yielded treatment (T₄) in 2014-2015, which was 349mm in 2013-2014. The economic return/tree was also the highest (Tk. 11607) from the irrigated trees (T₄) in 2014-2015.

Effect of alternate wetting and drying furrow irrigation on water use and yield of maize: This research was carried out to investigate the effect of alternate furrow irrigation on crop performances, seasonal water use (SWU) and water use efficiency (WUE) of maize at IWM research field, BARI, Gazipur and ARS, BARI, Dinajpur. The field experiments were laid out in randomized complete block design in a split plot design with nine treatments replicated thrice. The treatments were accommodated by three irrigation levels (I₁, I₂ and I₃: Irrigation water applied up to 100%, 80%

and 60% field capacity, respectively) and three methods (M_1 , M_2 and M_3 :Alternate wetting and drying furrow irrigation(AWDFI), Fixed wetting and drying furrow irrigation (FWDFI) and Traditional furrow irrigation (TFI), respectively). Results showed that AWDFI could maintain approximately similar grain yield compared to TFI with almost 50% reduction in irrigation water when irrigated with 100% FC. The interactive effect of irrigation levels and methods significantly reduced crop growth rate(CGR)in the crop biomass and grain yield among the treatments while the same level of irrigation produced insignificantly difference between the alternate furrow irrigation (M_1) and traditional furrow irrigation (M_3) method, but significantly better CGR and grain yield compared to the fixed furrow irrigation (M_2) method. AWDFI and TFI produced around 7.8 and 7.9 t/ha in Gazipur and 9.5 and 9.9 t/ha in Dinajpur, respectively when irrigation water was applied up to 100% field capacity. AWDFI saved 39, 35, and 33% SWU at Gazipur and 27, 24 and 19 % SWU at Dinajpur compared to TFI when irrigation water applied up to 100, 80 and 60% FC, respectively. WUE was substantially improved by AWDFI. WUE was higher around 38, 34 and 31% in Gazipur and 23, 22 and 19% in Dinajpur in AWDFI system than TFI when irrigating with 100, 80 and 60 % FC.

Performance of fertigation system on strawberry cultivation: This study was carried out to assess the fertigation system on the yields of advanced strawberry line FA-016 at the IWM Research Field, BARI, Joydebpur, Gazipur during the two Rabi seasons of 2013-2014 and 2014-2015. Two drip irrigation levels i.e., drip irrigations at two and three days interval and three fertilizer doses ($N_{110}K_{100}P_{40}S_{25}$ kg/ha, $N_{75}K_{75}P_{40}S_{25}$ kg/ha and $N_{50}K_{50}P_{40}S_{25}$ kg/ha) were tested. Soluble fertilizers like urea and muriate of potash were applied with water through drip system. Fertigation was done in four times at different growth stages. On average, growth parameters of strawberry were influenced insignificantly by different levels of irrigation and fertilizer application among the treatments. On average, the treatment T_2 (Drip irrigation at 2 days intervals

with moderate fertilizer dose of N_{75} , P_{40} , K_{75} , and S_{25} kg/ha) produced the highest marketable fruits yield (11.53 t/ha) while the minimum marketable fruit yield (10.39 t/ha) was found in treatment T_6 where irrigation was applied at 3 days intervals with lowest fertilizer dose of N_{50} , P_{40} , K_{50} , and S_{25} kg/ha. The quality parameters (pH, total soluble solids, vitamin A and percentage of total sugar) were found almost similar among the treatments. The seasonal water use varied from 10.5-16.8cm throughout the growing period. The mean water productivity was varied from 7.62-8.51kg/m³. On an average, the highest net margin (Tk. 17,98,102/ha) and benefit-cost ratio (6.01) was obtained from treatment T_2 where irrigation water was applied at 2 days intervals with moderate fertilizer dose of N_{75} , P_{40} , K_{75} , and S_{25} kg/ha. Proper amount of irrigation water with an optimum (N_{75} , P_{40} , K_{75} , and S_{25} kg/ha) fertilizer dose produced maximum yield and consequently increased the net margin and benefit-cost ratio.

Growth, yield and water productivity of garlic under sprinkler irrigation: A field study was conducted in the experimental field of IWM Division, BARI, Gazipur during November to March of 2013–14 and 2014–15 to investigate the effect of different irrigation regimes on growth, bulb yield and water use pattern of garlic under sprinkler irrigation system. Six irrigation regimes were: T_1 - Surface irrigation where crop was irrigated at 15 days interval; T_2 – Sprinkler irrigation at 40% of ETo; T_3 – Sprinkler irrigation at 60% of ETo; T_4 – Sprinkler irrigation at 80% of ETo; T_5 – Sprinkler irrigation at 100% of ETo; and T_6 – Sprinkler irrigation at 120% of ETo. Marginal water productivity (MWP) and elasticity of water productivity (EWP) were calculated using the relationship between bulb yield and seasonal evapotranspiration (SET). A continuous increasing trend in growth parameters and yield was recorded with the increase in SET up to 100% ETo. However, with further increase in SET the same was decreased. In the first year, SET requirement was 254 mm for obtaining maximum yield of 9.10 t/ha while in the following year, SET was 240 mm with maximum yield of 6.43 t/ha. But in both the years, the highest water productivity was achieved

with relatively low SET values. The highest water productivity (WP) of 3.76 kg/m^3 and 3.03 kg/m^3 was achieved with SET values of 211 mm and 191 mm, respectively, in the first and second year. In terms of bulb yield and WP, sprinkler irrigation found superior over the surface (conventional) one. Sprinkler irrigation with 100% ETo found most suitable for bulb yield of garlic. However, WP was found the highest in sprinkler irrigation with 80% ETo and after that declined with the increase in ETo. Hence, in water constraint situation, 80% ETo would be the most appropriate irrigation level for garlic production with sprinkler irrigation system.

Response of wheat to irrigation with saline water in coastal saline areas: An experiment was conducted at the Agricultural Research Station, BARI, Benarpota, Shatkhira during Rabi season of 2013-2014 and 2014-2015 to investigate the response of wheat to supplemental irrigation with saline water in coastal areas of Bangladesh. On average over two years, the highest grain yield of 4.42 was obtained from treatment T_1 insignificantly followed by T_4 with the yield of 4.05 t/ha while the lowest (2.96 t/ha) was obtained from T_1 that received only one irrigation at CRI stage. Slight variation in grain yield between T_1 and T_4 implied that irrigation with saline canal water at the grain filling stage had little detrimental effects on the growth and yield attributing characters of wheat. Irrigation with saline ground water had almost no effect on increasing soil salinity; rather it helped to decrease soil salinity. On the other hand, canal water irrigation slightly increased soil salinity and consequently grain yield was slightly decreased. A significant difference in yield between two irrigation with BAW and three irrigations-two with BAW and one with canal water indicate that moisture than moisture stress was more harmful than salinity stress.

Development of appropriate water management practices for increasing crop water productivity in saline area: A study was conducted during 2014-2015 at ARS, Benarpota, Satkhira with the two most common and intensive cropping patterns

viz. Mustard (BARI 14)- Boro (BR-47)- T.Aman (BINA 7) and Wheat (BARI Gom 25)-Mung (BARI 6)-Taman (BINA 7) of that area and compared to evaluate their comparative profitability in terms of yield, water use and economic analysis. Four different irrigation treatments were tried for different crops in a pattern. The treatments were: for wheat- Farmers' practice (T_1), irrigation at CRI (T_2), at CRI and maximum tillering (T_3) and at CRI, maximum tillering and flowering (T_4) stages; for mustard- Farmers' practice, irrigation at pre-flowering, at pod formation and at pre-flowering and pod formation stages; for mungbean- Farmers' practice, irrigation at vegetative, at flowering, and at vegetative and flowering stages; for T.Aamn- no irrigation, irrigation at booting, at grain filling, and at booting and grain filling stages; and for Boro rice- Farmers practice (ponding up to 3-5 cm), alternative wetting and drying (AWD) method with 20 cm(T_2), 30 cm (T_3) and 40 cm (T_4) depth. Rice equivalent yield (REY) was varied with the different irrigation treatments. In Mustard-Boro-T.Aman cropping pattern, rice equivalent yield was found the highest of 13.43 t/ha under T_2 irrigation regime. While the lowest REY of 12.86 t/ha was obtained in treatment T_4 . On the other hand, in Wheat-Mung- T.Aman cropping pattern, the highest REY of 15.61 t/ha was obtained from T_4 irrigation regime and the lowest was from treatment T_2 . Total water use and water productivity (WP) were found lower in non rice dominant pattern Wheat-Mung-T.Aman than rice dominant pattern Mustard-Boro-T.Aman pattern. Total water use varied from 1372 mm to 1720 mm with minimum in treatment T_4 and maximum in control treatment T_1 under Mustard-Boro-T.Aman pattern. In contrast, TWU was found the highest (1072 mm) in irrigation regime T_4 and the lowest was found in the most deficit treatment T_2 (836 mm) in Wheat-Mung-T.Aman pattern. In Mustard-Boro-T.Aman pattern, WP was ranged from 0.76 to 0.94 kg/m^3 with the lowest in T_1 and the highest in T_4 . While in Wheat-Mung- T.Aman pattern, WP ranged from 1.44 for T_3 to 1.49 $T_1 \text{ kg/m}^3$. Between the two patterns, the highest gross return (Tk. 93850/ha), gross margin (Tk. 48980/ha) and BCR (2.04) was realized by Wheat-Mung-

T.Aman cropping sequence with T₄ water regime closely followed by treatment T₃. Though irrigation regime T₄ gave the best result in terms of yield and profitability, considering the water scarcity in saline areas the irrigation treatment T₃ can also be suggested for farmers.

Field trial of screened advanced wheat genotypes/lines in saline soil: A field trial was conducted at the Agricultural Research Station, Benarpota, Satkhira; Bangladesh Agricultural Research Institute during rabi season of 2014-2015 to evaluate the performances of selected three wheat genotypes in saline soil at field condition in coastal areas of Bangladesh. The treatments of the experiment include: T₁ = BAW - 1147, T₂ = BAW - 1157 and T₃ = BARI Gom 25. Medium saline canal water (4.6-6.8 dS/m) was used for irrigating crops. The highest grain yield (4.86 t/ha) was obtained from BAW- 1157 wheat genotypes comparing to other two genotypes BAW-1147 and BARI Gom-25. The soil salinity levels at different growth stages was found ranging from >2 dS/m to <11 dS/m. Overall, BAW-1157 performed the best under the saline condition in terms of yield and water productivity.

Yield of watermelon as affected by different levels and methods of irrigation in coastal area: The experiment was conducted in farmer's fields at Amtali, Barguna district during the rabi season of 2015 to investigate the effects of irrigation levels and methods on watermelon in saline soils of coastal area. The field experiment was laid out in a randomized block design with four irrigation treatments of watermelon (Hybrid-Big family), replicated thrice. The treatments were as: T₁ = Farmer's practice (Four irrigations at different growth stages from initial vegetative to fruit setting with mulch), T₂ = Drip irrigation in raised bed at 3 days interval from initial vegetative to fruit setting with mulch, T₃ = Drip irrigation in raised bed at 5 days interval from initial vegetative to fruit setting with mulch, T₄ = Ring basin method at 15 days interval from emergence to fruit setting with mulch. Soil salinity (in situ electrical conductivity) increased from 5.8dS/m at the time of sowing to 9.6 dS/m at the time of harvest with

farmer's practice irrigation management. Increasing irrigation frequency of watermelon from 22 to 15, 5 and 3 d intervals greatly reduced the build up in soil salinity during the second half of the season, and increased watermelon yield by more than 23 to 33%. The highest fruit yield of watermelon was around 40.3 and 35.2 t/ha at 5and 3d irrigation intervals, respectively, while the farmer's practice (T₁) and ring basin method (T₄) produced the lower yield (34.8 and 27.1 t/ha) at 18 and 15 d irrigation intervals, respectively. The highest total water productivity of watermelon was 15.8 kg/m³ at 5 d irrigation intervals (T₃) and lowest (8.2and 8.8 kg/m³) at 15 and 18 d intervals, respectively. The results show that high yields of watermelon (40.3 t/ha) can be achieved on moderately saline soils of the coastal zone with drip irrigation at 5 d intervals with mulch (T₃).

Estimation of groundwater recharge using Lysimeter: The objective was to estimate the rate of downward movement of rain-water (recharge). In two series, 10 Lysimeter boxes (5 in each series, 2m×1m×1.5m each) were used in this study. Drainage was collected and the volume was measured from each Lysimeter box, on the next day of each heavy rainfall events (to avoid restriction on bottom boundary layer), and 7 days interval for the remaining days (including moderate rainy days). The volume was converted to depth of water (mm) by dividing the area of the lysimeter box. The collected drainage was considered as equivalent of recharge. The mean annual recharge was estimated as 39 mm (with SD 21.5 mm and CV 57%), which is about 2 % of yearly rainfall.

Quantifying natural groundwater recharge using tracer technique: The objective was to estimate the yearly recharge under field condition. Chloride tracer was applied as a pulse at 20cm depth within the soil profile (in the field). Infiltration of precipitation transports the tracer downward. The subsurface distribution of applied tracers was determined in October by digging a trench for sampling. The Cl concentration was determined by Mohr method, using micro-burette having 0.01 mm readable facility. The vertical

distribution of the tracer was used to estimate the velocity and the recharge rate was calculated as using standard relationship. The average recharge rate in this method was found as 162 mm (8 % of yearly rainfall).

Irrigation management for wheat lines/cultivars

under saline condition: The experiment was aimed to find out the effect of brackish/saline water on wheat yield and to find out the optimum irrigation management option for higher yield. The experiment was conducted at Kharibila, Satkhira Sadar. The experimental design was RCB (with split-plot arrangement) with 3 replications. Irrigation treatments were allocated in the main plot. The main plot size was 4 m×3 m. The irrigation treatments were: T₁=Control (no irrigation), T₂=One irrigation at vegetative stage with *canal water* (Canal water means rainwater harvested in natural/man-made canal), T₃=One irrigation at vegetative stage with saline *STW water*+Gypsum application (@208 kg/ha, T₄=Irrigation at vegetative and heading/flowering stage with *canal water*, T₅=Irrigation at vegetative stage with saline *canal water*+Gypsum application (@208 kg/ha, T₆=Irrigation at vegetative and heading/flowering stage with *STW water*+Gypsum application @ 208 kg/ha. The cultivars were: V₁=L-880-43, and V₂=BARIghom-26 (as check). Irrigation treatments showed significant effect on plant height and grain yield. The highest yield was obtained in treatment T₅ (in which irrigation was provided at vegetative stage with saline *STW water*+Gypsum application (@208 kg/ha) which is statistically similar with T₂, T₃, and T₆. The lowest yield was recorded with T₁. Due to rainfall, the control treatment (T₁) produced reasonable yield. The cultivars showed significant effects on plant height, spikelet/spike, number of grain/spike, 1000 grain weight and grain yield. The mutant line L-880-43 (V₁) produced higher yield compared to check variety BARIghom-26.

Response of sesame mutant (now, binatil-3) to water-logging: The experiment was aimed to determine the water-logging response and critical stage(s) of sesame mutant (developed by BINA) with respect to water-logging. The experiment was

conducted at the farm of BINA Head-quarter. The experimental design was RCB. The water-logging treatments were: T₁=Control (no water-logging), T₂=Water-logging for 24 hours at vegetative stage, T₃=Water-logging for 24 hours at flowering stage, and T₄=Water-logging for 24 hours at pod formation stage. Sesame seeds were sown on 20th March 2014. Water-logging was imposed as per treatments. The lowest yield was obtained when water-logging was imposed at vegetative stage followed by water-logging at flowering stage. The straw yield also followed similar trend. The root weight per plant at harvest (oven-dried at 60°C for 12 hrs) also indicated similar trend of sensitivity to water-logging (i.e. vegetative stage>flowering stage>pod formation stage).

Study on properties of Pabna sugar mill's effluent water: In order to judge the suitability of sugar mill's wastewater for irrigation, laboratory experiments were designed and conducted to evaluate the important properties of Pabna Sugar Mill's (PBSM) wastewater. The properties of wastewater samples collected from wastewater disposal canal of the PBSM during different times of crushing season and one sample of freshwater from a hand tubewell at the PBSM complex were determined in the laboratory. The electrical conductivity (EC) of PBSM's wastewater ranged from 1.0 dS/m to 1.2 dS/m and its pH varied from 6.5 to 7.2. These wastewater samples were richer than freshwater in terms of nitrogen (14.5-25 mg/l) and phosphorous (6-7 mg/l) content. Iron (0.39-0.45 mg/l), manganese (0.5-0.6 mg/l) and boron (0.3-0.4 mg/l) concentrations were higher in wastewater than in freshwater. Biological oxygen demand (BOD) and chemical oxygen demand (COD) of the wastewater ranged from 120 to 430 mg/l and 250 to 835 mg/l respectively. Temperature of wastewater was 40°C. The EC, BOD, COD, temperature and manganese contents of wastewater exceeded the threshold values for irrigation and, therefore, the wastewater was not suitable for irrigation without treatment. After primary treatment like cooling and mixing with

fresh water, sugar mills' wastewater can be used for irrigation purpose. Thus the wastewater will be a source of irrigation water which supplies nutrients to crops and it is environmental friendly.

1.3 Postharvest Technology of Crops

Effect of blanching on the quality of frozen product of carrot: The influences of blanching on the frozen product of carrots were investigated to determine the quality and shelf life of the products during storage in refrigerator for four months. There were ten treatments using three different blanching time and temperatures. The chemical compositions of the frozen products analyzed for the year of 2013-2014 and 2014-2015. The following results were found: the moisture contents were gradually increased, acidity contents of blanching carrots were decreased and P^H contents increased during storage. The β -carotene contents were increased and the Vitamin C contents were decreased after increasing the blanching time and temperature. On the other hand, the TSS contents were decreased on blanching with long time storage. Most of the enzymes were inactivated at 85°C for 2 min blanching. Therefore, the study results showed that the frozen carrots were stored well in home refrigerator up to three months using blanching temperature of 85°C for 2 minutes.

Storage stability of processed ginger paste: The effect of salt percentages and packaging materials of the processed ginger paste were investigated to determine the quality and storage stability of the products during stored in ambient condition for four months. There were fifteen treatments using three different packaging materials. The products were analyzed for two month in the year of 2014-2015. The following results were found: the acidity contents of the processed ginger paste were decreased and p^H contents were increased after increased the storage life of the products although used in different salt percentages. The paste was kept and stored up to 2 months in Glass container (GC) gives the significant increased in TSS. The intensity of light yellow color of the ginger paste were gradually increased with extend the storage period and turned yellow as evidence by increasing values of L^* and changing values of a^* and b^* accordingly. It was processed and stored in plastic container (PC) only the

results of 3% salt added seen no presence of bacteria up to 2 month but, 12% salt added gives the good results only one month of stored in ambient condition.

Osmotic dehydration of garlic: The experiment was conducted at Spices Research Center, Shibgonj, Bogra to study the drying behavior of garlic by osmotic dehydration (OD) and /or combined OD and air drying and development of dehydrated garlic products. The rate of extent of weight loss , moisture content, solid gained and normalized solid content (NSC) were strongly influenced by strength of osmotic solution, immersion time and were rapid during the first 6 hrs of osmotic dehydration. It is seen that as the solution temperature increases, the moisture content at any given time decreases. In other words, the rate of mass transfer increases with the increase in temperature. Thus %WL, %SG and NSC increased with increasing temperature. It is also found that the lower the thickness the higher is the %WL, %SG and NSC. Garlic slice/cloves were stored in alluminium foil packet and HDPE at refrigerated temperature as well as room temperature. Both products were acceptable in all the temperature up to 1 year's of storage.

Development of products from all spice leaves and its sensory evaluation: The experiment was concerned with the kinetics of dehydration of All Spice (*Pimentadioica*) leaves and development of All Spice products and its sensory evaluation. The All Spice leaves were treated with sodium chloride, sodium metabisulphite and hot water. Drying was done in two different ways: firstly, in a oven drying at constant temperature (40°C) and secondly, by sun drying ($35-40^{\circ}\text{C}$). Drying time were around 72 hr for oven and sun drying. The effects of treatments, packaging materials and storage time on the keeping quality of the all spice powder was evaluated. For conducting organoleptic taste test osmosed, blanched and sulphited dehydrated all spice powder packed in HDPE bag and stored at RT, the results for colour, smell, crispness and overall acceptability of 8 samples showed that the steam blanched all spice sun dried powder found best among other treated (osmosed , blanched and sulphited) and untreated sun and oven dried sample. In order to determine the suitability of blanched sun dried all spice powder in a curry, it was decided to conduct organoleptic taste test of chicken curry using 4 different samples. These are S₁: Normal spice (onion, garlic, ginger, turmeric, chilli, coriander, cumin) + blanched and sun dried all spice powder, sample no. S₂: Normal spice + all spice paste, sample no. S₃: was prepared with normal spice with Blackberry, nutmeg, cinnamon

and clove (BNCC) (Control) and sample no. S₄: was prepared using onion, garlic, ginger, turmeric, chilli with all spice sun dried powder. It is concluded that sample S₁ and S₂ are undoubtedly the best samples (among the samples tasted) since these samples secured the highest scores for almost all quality attributes and were equally acceptable at 5% level of statistical significance. Samples S₂ however secured the highest numerical score for each attribute except texture of sample. The control (sample S₃), secured the third highest score for all attributes, while sample S₄ though secured the lowest score for all attributes. Statistically all the samples were equally acceptable but there were little bit differences in score among each attributes.

Effect of vapor heat treatment on postharvest quality of tomato at ambient condition: The experiment was carried out at Postharvest Technology Laboratory, Postharvest Technology Division, BARI, Joydebpur, Gazipur during 19 March to 02 April, 2015 to study the effect of vapor heat sterilization on self life and decay control of BARI Tomato 14. There were twelve treatment combinations comprising three maturity stages full ripened, half ripened and matured green tomato at 55° C vapor heat of 5, 10 and 15 minutes durations and with nontreated. Acidity and vitamin C content significantly reduce during heating but very few differences observed at the end of 10 and 13 days of storage at 33° C ambient condition and total soluble solids and pH did not affected by the heating. Vapor heat effectively controlled weight loss and shrinkage of tomato, best performance observed in case of matured green tomato. Postharvest pathogenic activities were suppressed due to vapor heat treatment, so infection and rot slowed down. For that marketability and shelf life of tomato increased.

Effects of waxing and temperatures on the postharvest quality of pineapple during storage: The experiment was conducted to study the combined effect of temperature and wax treatments on the quality and shelf life of pineapple (*Ananas Comosus L. Merr.*) CV. 'Honey Queen' during cold storage. Cold storage is one of the methods for prolonging postharvest life of pineapple fruit. A major problem of this method is chilling injury symptoms in fruits due to low temperature and thus deterioration of quality and nutritional values occurs. The treatment combinations of temperature (11°C) and Sta-Fres 2952 wax (@ 60 g/l) was more effective in alleviating chilling injury which delayed the changes in firmness, flesh color and weight loss as compared to the control fruits. The combination of the above mentioned treatments also

decreases titratable acidity and total soluble solid when compared to those in control fruits. The treatment combinations also improved total sugars and ascorbic acid content in pineapple fruit and maintained the fruit quality and shelf life for 21 days of storage at 11° C and 88±2% relative humidity.

Effect of packaging technique on the quality and shelf life of bitter gourd: The experiment was conducted to evaluate the effect of packaging technique on the quality and shelf life of bitter gourd (*Momordica charantia L.*) using passive modification of modified atmosphere packaging system. The modified atmosphere was created by making perforation in the polypropylene packets. Bitter gourd packaging in 1.5% perforated polypropylene packet resulted substantial reduction in losses due to weight loss and rotting/decay. These treatment combinations also considerably retained vitamin C and β-carotene content. Under this condition the retention of quality and shelf life of bitter gourd could be extended up to 2 days more at ambient condition as compared to vegetables kept without packaging.

Study on the sprouting behavior of potato using chemicals and some essential oils during storage: Control of sprouting during storage of potatoes are critical to the maintenance of quality and profitability. CIPC (chlorpropham) is widely used as a sprout inhibitor for table and processing potatoes. It is also prime concerns regarding consumer safety of CIPC residues. There is a need for alternative methods for sprouting and disease control in stored potatoes. A variety of 'natural' products including ground dill, ground cloves, clove oil, garlic powder, ground peppermint or peppermint oil were tested for their ability to suppress sprouting. In this trial sprout suppression was examined on the basis of sprouting ability up to 21 days after treatments.

Determination of formaldehyde in selected fruits and vegetables: The experiment was conducted to find out an easy and suitable method to detect formaldehyde in fruits and vegetables. This method based on spectrometric analysis. Some common fruits like mango. Six mango variety (Khirshapat, Langra, Harajam, Amropali, Lakshmanvog and Dudhshar) were evaluated for detection and quantification of naturally occurring formaldehyde. Two cultivars Khirshapat and Langra produced 0.43ppm and 1.08 ppm formaldehyde

naturally at full ripe stage and 0.13 ppm and 2.70 ppm at over ripe stage. Local variety Harajam, Amropali, Lakshmanvog and Dudhshar produced more formaldehyde naturally in full ripe stage than over ripe stage.

Effect of ripening chemical application at different stage of maturity on postharvest quality of tomato:

The experiment was conducted to evaluate the effect of ripening chemical application at different stage of maturity on postharvest quality of tomato. The tomatoes with various stages of maturity (half ripe, breaker stage, mature green and immature green) were used in the study for ripening with application of ripening chemical (ethephon @750 ppm) with an absolute control (ripe tomatoes without application of ethephon). The fruits were assessed for physiological changes such as ripening percentage, firmness and pulp recovery, biochemical aspects such as TSS (%), titratable acidity (%), ascorbic acid content (mg/100g), total carotenoids (mg/100g). The data were recorded at 3, 6 and 9 days after storage. Tomato harvested after maturation showed enhanced ripening process with better quality parameters and increased pulp recovery whereas the immature tomato did not recover 50% pulp at edible stage also. From the experiment it was found that tomatoes harvested at maturity maintains better quality in all aspects though ripening chemical is used for ripening the fruits.

Soils, NRM

PROJECT DEVELOPMENT AND IMPLEMENTATION

Development and coordination of projects are the major responsibilities of BARC. The Soils Unit of BARC is working in line with the mandate of the Council. The Unit oversees the soil fertility and fertilizer management related programs in the country. During 2014-15 the Unit has been published the Project Completion Report (PCR) of four coordinated Sponsored Public Goods Research (SPGR) Sub-Projects under the National Agriculture Technology Project (NATP) funded by the Word Bank, IFAD, IDA and GoB. The Member-Director (NRM), BARC was the Coordinator and CSO and PSOs of the Unit were working as the Associate Coordinators of the Sub-Projects. Besides, the Unit also looked after the other soil fertility and fertilizer management related single component SPGR Sub-Projects of NATP implemented by different NARS institutes in the country. The SPGR Sub-Projects those were coordinated and implemented by Soils Unit of BARC are as follows:

SPGR Sub-Projects coordinated and implemented by Soils Unit of BARC

Sl. No.	Sub-Project Title	Organization
Coordinated Sub-Project		
1.	Land Productivity and Its Enhancement through Utilization of Surface Water in Coastal Area of Bangladesh	BARC, BARI and SRDI
2.	Carbon Sequestration in Soils of Bangladesh	BARC, BRRI, BINA and BSMRAU
3.	Coordinated Project on Arsenic in Soil-Plant-Water System	BARC, BARI, BRRI and SRDI
4.	Coordinated Project on Soil Fertility and Fertilizer Management for Crops and Cropping Patterns	BARC, BARI, BRRI, BINA, BJRI, BSRI, SRDI and BAU
Single Component Sub-Project		
5.	Updating of Fertilizer Recommendation through Interpretation of Research Results Generated by the NARS Institutes	BARC
6.	Development of Nitrogenous Bio-fertilizer for Sugarcane with free-Living and Associative Bacteria Using Biological Nitrogen Fixation (BNF) Technology	BSRI

Besides, the following two international projects funded by Asian Food and Agriculture Cooperation Initiative (AFACI) are being implemented under the supervision of Soils Unit of BARC.

International projects implemented by Soils Unit of BARC

Sl. No.	Sub-Project Title	Organization
1.	Agricultural Land Management for Improving Soil Fertility and Irrigation Efficiency	BARC and BINA
2.	Production and Service of Agro-meteorological Information for the Adaptation to Climate Changes	BARC and BUET

POLICY LEVEL CONTRIBUTION

Activities of Fertilizer Technical Sub-Committee

Fertilizer Technical Sub-Committee was formed by the Ministry of Agriculture (MoA) in 1997 to help the National Fertilizer Standardization Committee. Member-Director (NRM), BARC works as the convener and Additional Director (Implementation), DAE as the Member Secretary of the committee. The committee comprises of 19 (nineteen) members with the CSO (Soils), BARC, CSOs of Soil Science Divisions of different NARS institutes, CSO, OFRD, BARI; representatives from different concerned organizations like Departments of Environment, Livestock, Fisheries, BSTI, SRDI, BADC, BCIC etc. During 2014-2015, two regular meetings and two special meetings of Fertilizer Technical Sub-committee were held with Member-Director (NRM) in the chair. A number of organic and chemical fertilizers and PGRs were evaluated in these meetings of which 4 organic fertilizers, 2 chemical fertilizers and 4 plant growth regulators were recommended for standardization to the National Fertilizer Standardization Committee headed by the Secretary, Ministry of Agriculture. Moreover, PSO (Soils), BARC has been working as the convener of a 3-member monitoring committee for evaluating organic fertilizer factories in the country.

RESEARCH MANAGEMENT AND COORDINATION

Soils unit of Natural Resources Management Division of BARC is organizing a Soil Fertility and Fertilizer Management Research Review and Programme Planning workshop annually. The workshop was held at BARC during 1-3 September 2014 with scientific

professionals involved in soils and fertilizer management research in the NARS institutes of the country. Research programme conducted in all NARS institutes during 2013-2014 were reviewed in the workshop. The workshop was divided into seven technical sessions and one recommendation session. The technical sessions were divided into different areas of soil fertility and fertilizer management research and environmental issues. Besides reviewing on-going research programmes, new research programmes proposed for 2014-15 were also discussed in the workshop. Scientists from different NARS institutes took part in the discussion, contributed and shared their knowledge, thoughts and experiences for improvement of the programmes and avoid duplication.

MONITORING AND EVALUATION

Soils Unit of BARC is actively involved in the regular monitoring and evaluation program of BARC. Scientists of Soils Unit worked as the team member of the Monitoring and Evaluation teams formed by the Planning and Evaluation Division of BARC. Member-Director (NRM) and Chief Scientific Officer (Soils), BARC worked as the Team Leaders of two monitoring groups formed for monitoring the SPGR Sub-Projects in 2014-15 and monitored the activities of the Sub-Projects assigned to their respective groups. Besides, two Principal Scientific Officers of the Unit also worked as the team members of the monitoring groups and actively took part in the monitoring activities. BARC sponsors contract research projects for generation and dissemination of technologies. The Soils unit has the responsibility to evaluate the Soils and Fertilizer Management related proposals. The research grants are allocated to both public and private sector organizations including universities and NGOs.

Other Activities

Scientists of Soils unit worked as the members of the following committee-

- Agriculture and Food Committee of BSTI
- Fertilizer and Allied Products Committee of BSTI
- Fertilizer Distribution Committee of BCIC
- Steering Committee for Establishment of Laboratory of SRDI
- Project Management Committee of Soil Resources Management and Strengthening Farmers Services Project.
- Evaluation of SPGR Sub-projects under Soils and Water management.
- Served as Member Secretary of Tender Evaluation Committee of Procurement of Specialized equipment and logistics by frontier research by NARS Institutes in connection with SPGR Sub-project under PIU-BARC, NATP Phase-1
- Served as Chairperson of the Tender Opening Committee for Procurement of Specialized equipment and logistics by frontier research by NARS Institutes in connection with SPGR Sub-project under PIU-BARC, NATP Phase-1
- Focal Point, BARC on “Establishing National Land use and Land Degradation Profile toward Mainstreaming SLM Practice in Sector Policies” under Department of Environment.

As the members of these committee scientists of Soils Unit regularly attended the meetings and contributed with comments, opinions and suggestions.

AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY

POLICY LEVEL CONTRIBUTION

Different policy oriented comments were sent to the Ministry of Agriculture according to their needs /requirements. Some of those are as follows:

- (i) Comments on the Report of UNESCAP prepared for 70th session (Phase-II) of the Economic and Social Commission for Asia and the Pacific, 2014
- (ii) Inputs for the inter-ministerial meeting on ‘International Workshop on Blue Economy’

- (iii) Inputs for making English version of Bangladesh Economic Review 2015
- (iv) Talking Points for the 3rd meeting between Bangladesh-India Joint Consultative Commission (JCC)
- (v) Expert comments on Terms of Reference (ToR) of Baseline Studies of Bangladesh Delta Plan 2100 Formulation Project
- (vi) Talking Points for the 7th meeting between Bangladesh-EU Joint Consultative Commission (JCC)
- (vii) Comments on “Shaikh Hasina National Institute of Youth Development Act 2015 (draft)”
- (viii) Inputs for making Bengali version of Bangladesh Economic Review 2015
- (ix) Comments on “Agricultural Labour (minimum wages) Ordinance 1984”
- (x) Comments on “Textile Industries (Registration and Coordination) Act-2015 (draft)”
- (xi) Inputs on updated position of Bangladesh for Graduation from LDCs based on three Criteria and Indicator according to LDC Handbook
- (xii) Comments on “National Industry Policy 2015 (draft)”
- (xiii) Comments on the Report of Baseline Study entitled “Agriculture and Food Security” under the project of Preparation of Bangladesh Delta Plan 2100
- (xiv) Comments on the ratification of “Trade Facilitation Agreement of WTO”
- (xv) Comments on the Report of “Bangladesh’s Alignment to The WTO Trade Facilitation Agreement” prepared by IFC
- (xvi) Comments on the Outcome Document (zero draft) of the “Third International Conference on Financing for Development” in Ethiopia.

Highlights of Research Programmes/Technology released by NARS Institutes

Bangladesh Agricultural Research Institute (BARI)

BARI 1

Expert Elicitation for Estimating Varietal Adoption of Wheat in Bangladesh

The study was undertaken to find out variety wise adoption rate of wheat in Bangladesh through expert elicitation procedure. Many varieties have been developed by WRC but in details of varietal

information and adoption information database was not developed which is very important and valuable for the scientist and policy planner. This study through expert elicitation for constructing detail varietal development and adoption database is timely and necessary for the research institute. From all over the Bangladesh 14 experts was invited to share their valuable knowledge and experience on wheat cultivation and adoption in the country. The average age of the experts were 54 yrs and average experience on wheat adoption was 22.65 yrs. The wheat expert informed that 13 major varieties are adopted by the farmers in the recent year(2013-14). Among those varieties, BARI Gom 24 (Prodip) covered highest cultivated area (186026 ha) which shared 41.03% of total wheat cultivated area. BARI Gom 21 (Shatabdi), BARI Gom 26 and BARI Gom 23 (Bijoy) ranked 2nd, 3rd and 4th position according to the share of cultivated area covered. The seed production information showed that BADC the only wheat seed producer supplied 24912.60 mt of wheat seed in the year 2013-14. The trend of seed production by different wheat variety revealed that over the period 2010-14, the seed production of BARI Gom 24 (Prodip) increased and BARI Gom 21 (Shatabdi) decreased. Increased seed production trend of Prodip variety leaded to highest adopted area of that variety. The main reason behind highest adopted area of Prodip variety was it's very attractive attributes like high yield, big spike, large grain and lodging tolerance character. Although the Prodip covered highest area but other newly developed variety like BARI Gom 25, BARI Gom 26, BARI Gom 27 and BARI Gom 28 were the most promising varieties which showed increasing adoption path among the expert. These varieties have very good potentiality due to having short duration, tolerance to terminal heat stress, tolerant to salinity and lodging attributes. Satisfying higher demand for wheat consumption and ensuring food security through providing alternative to rice are the major concerning issue of the policy planner and the scientist.

BARI 2:

Expert Elicitation for Estimating Varietal Adoption of Maize In Bangladesh

The study was undertaken to find out variety wise adoption rate of maize in Bangladesh through expert elicitation procedure. Very valuable information about maize was collected through the elicitation of 14 experts who had expertise of different discipline of maize sector through involving in maize research and

extension at different corners of the country. On an average, the expert's age was 47 years, and had 12 years of experience on maize research and extension. The seed releasing authority Bangladesh released 86 varieties in the period 1986-2014. Among those varieties highest number of variety released in the period 2006-10 followed by 26 released variety in the period 2010-2014. Although all the varieties are released by the authority, but 21% of them are developed and released by the public research institute. Highest percentage of variety cultivated within the period 1986-2014 were hybrid which developed by nationally and imported by private organization. The adoption rate information provided by experts revealed that 17 different varieties were cultivated on highest percentage of cultivation area. Among those cultivated varieties, Dekalb 981 covered highest percentage (13.78%) of cultivation area followed by Miracle (11.11%), NK 40 (9.03%) and Pioneer 30V92 (7.75%). The highest adopted variety Dekalb 981 covered 42,167 ha of maize land which is followed by Miracle (33,997 ha), NK 40 (27,632 ha), Pioneer 30V92 (23,715 ha). Very recently the demand for Dekalb 981 maize increased due to its high yielding attribute. Another variety Dekalb 942 is getting popularity among the farmers due to its heat tolerant and lodging resistant attributes. Increase popularity of one variety indicates decreasing demand of another variety. The experts identified that the demand for NK 40 is decreasing due to its lower yield compare to newly introduced variety and susceptibility to leaf blight disease. The publicly developed maize variety can't keep their position in the varietal competition leaded by imported variety. In spite of that the national research and development of maize variety is going on in a full sewing. Variety developed by NARS with the support of CIMMYT has a small share in adoption status. This indicated that there is a very wide scope to give more emphasis on varietal improvement of maize by NARS. To ensure food security in the country, it is very important to encourage and support the farmers to grow more maize through providing public and imported maize variety as well as improved cultivation technology to the farmers.

BARI 3

Expert Elicitation for Estimating Varietal Adoption of Lentil In Bangladesh

The study was undertaken to find out variety wise adoption rate of lentil in Bangladesh through

expert elicitation procedure. Many varieties have been developed by BARI and BINA but in details of varietal information and adoption information database was not developed which is very important and valuable for the scientist and policy planner. This study through expert elicitation for constructing detail varietal development and adoption database is timely and necessary for the research institute. From all over the Bangladesh 12 experts were invited to share their valuable knowledge and experience on lentil cultivation and adoption in the country. The average age of the experts were 51 yrs and average experience on lentil adoption was 21 yrs. The lentil expert informed that 16 major varieties are adopted by the farmers in the recent year (2013-14). Among those varieties, Barimasur-6 covered highest cultivated area (54,642 ha) which shared 30.04% of total lentil cultivated area. Barimasur-4, Barimasur-3 and Barimasur-5 ranked 2nd, 3rd and 4th position according to the share of cultivated area covered. The seed production information showed that BADC the only lentil seed producer supplied 2151 mt of lentil seed in the year 2009-2013. The trend of seed production by different lentil variety revealed that over the period 2009-13, the seed production of Barimasur-3 increased sharply but Barimasur-4 gradually decreased. The adoption of variety Barimasur-6 increased due to its high yield attribute. The another variety Barimasur-4 and Barimasur-3 adoption increased due to its high yield, resistant to rust disease attributes which showed increasing adoption path among the expert. Satisfying higher demand for lentil consumption and ensuring food security through providing alternative to winter crops are the major concerning issue of the policy planner and the scientist.

BARI 4

Profitability of Betel Leaf Cultivation in Some Selected Areas of Bangladesh

The study was conducted in two betel leaf growing areas namely Jessore and Patuakhali district during 2014-15 to assess the physical productivity, profitability and to explore the constraints to betel leaf cultivation. The findings of the study revealed that betel leaf cultivation was profitable in the study areas, although BCR in the first and second years was below one due to high investment cost. Gross

return of betel leaf cultivation was highest in the fifth year. Highest yield received by the farmers also in the fifth year. The benefit cost ratio was found highest in fifth year followed by 6-10 year and 11-20 year. The benefit cost ratio at 12%, 15% and 20% rate of interest were 1.23, 1.21 and 1.18 respectively. IRR was calculated 76% in current situation, IRR 20% was found by 10% decrease of return and IRR 22% by 10% increase of cost. The result indicates that betel leaf cultivation is profitable under changing situation of sensitivity analysis. Farmers faced some constraints like leaf rot disease, high price of boroj materials, vine died, lack of capital, low price of betel leaf, high price of oilcake, non-availability of modern variety etc.

BARI 5

Assessment of Bari Mango Varieties in Comparison with other Varieties

This study was undertaken to know the existing status of BARI released mango varieties in contrast with other varieties in the field level. Three large commercial firms having mother orchard mango trees at Dinajpur (Basherhat), Nilphamari (Chilahati) and Manikganj (Nayadingi) were selected purposively. More than forty varieties were found in the surveyed commercial firms and among the ten BARI mango varieties, four varieties namely BARI Aam-1, BARI Aam-2, BARI Aam-3 and BARI Aam-4 were found there. Among all the varieties, BARI Aam-3 appeared to be the best in all the firms in terms of last four year sale of stions (stock+scion), of which amount of sale was much higher than that of other remaining varieties' accumulated sale. Hence, it is easily comprehended that BARI Aam-3 is likely to be the single most popular variety to be unparalleled with any other variety. BARI Aam-3 is the glory of BARI. Apart from this variety, Kiozoi, Haribhanga, BARI Aam-4 and Mohachanak were identified as the most promising varieties. However, BARI Aam-3 is known as Amropali not as BARI Aam-3 in the field. People even do not know that this variety is a BARI released variety. Therefore, initiative should be taken to acquaint this excellent variety as BARI Aam-3 in the field.

BARI 6

Socioeconomic Impacts of Wheat Seed Storage at Household Level in Bangladesh

Small and marginal farmers have little access to improved seed from institutional sources and are thus largely excluded from the benefits of new varieties. The production and storage of improved varieties seeds at the household (HH) level can successfully overcome this problem. With this aim CSISA-CIMMYT (Cereal Systems Initiative for South Asia) project in Bangladesh have been working since 2011. Therefore, an attempt was made to assess the impacts of wheat seed storage systems at HH level, with a particular emphasis on how the farmers are benefited by doing the seed storage business. The study analyzed data and information collected at random from 210 supported and 60 non-supported farmers spread over three wheat growing districts namely Mymensingh, Faridpur and Rangpur. The study revealed that wheat farmers used different storage containers and showed the highest level of satisfaction towards plastic sac along with poly bags and plastic/metal drum due to cost effectiveness and seed quality maintenance. On an average, supported and non-supported farmers retained respectively 103 kg and 100 kg of seed at household level due to own use (79-85%), sale for higher price (63-65%), timely sowing (28-35%), and higher yield (27-37%). They sold most of their seeds to neighbouring farmers, local markets, and dealers. Wheat seed storage at household level was a profitable business to most of the respondent farmers. They could earn a reasonable net income (Tk.1127-Tk.1210) from seed storage. The farmers who stored seed in plastic/metal drum received the highest net income due to higher storage capacity, less storage cost, and higher seed price. The wheat storage program has created a lot of socioeconomic impacts in the study areas. A substantial increase was recorded in wheat area, wheat productivity, and financial benefit of the wheat farmers as a whole. Nevertheless, improved wheat seed is now available at farm level and most farmers become enthusiastic towards improved wheat cultivation because of this program. Respondent farmers did not face any critical problem during seed storage. The study strongly recommends that the existing training and dissemination program should be extended to other new and promising areas for fostering wheat

cultivation as well as improving farmers' income in Bangladesh.

BARI 7

Financial Impact of Shifting of Land Under Cereal Crops to Mango Cultivation in Selected Areas of Bangladesh

The study was conducted in three mango growing districts namely Chapai Nawabganj, Natore, and Rajshahi during 2014-2015 to estimate the financial benefit of shifting cereal lands to mango production, factors influencing shifting decision, and explore related problems of mango cultivation in the study areas. A total of 180 farmers taking 60 farmers from each district were selected randomly for the study. About 49% lands were shifted to mango cultivation from cereal crops which was higher in Chapai Nawabganj (55%) followed by Natore (48%) district. The main reason of this shifting was reported to be higher profit compared to other crops. The average total cost of mango cultivation was Tk. 1, 33,889 per hectare. Higher cost was observed in the 16th -20th year of garden (Tk. 1, 52,010) followed by 11th -15th year (Tk. 1, 48,952). The average yield of mango was found to be the highest in 16th – 20th year (26.48 ton/ha) followed by 11-16th year (19.38 ton/ha). Per hectare net return from mango cultivation was Tk. 1, 75,244. Total cost of mango cultivation was 10% higher than Boro-Fallow-T.Aman cultivation. On the other hand, total cost was about 40% lower than Wheat- Jute- T.Aman, Wheat-Aus-T.Aman and Potato-Fallow-T.Aman. The net return from mango cultivation was 75% higher than other cropping patterns. The shifting of cereal lands to mango cultivation was found to be a profitable enterprise since the BCR (2.89), net present value (Tk. 33, 71,166) and internal rate of return (39%) was very high. Relative income, farm size and education turned out to be positively significant, whereas age was negatively significant for shifting decision from cereal crops to mango cultivation. Insects and diseases infestation, non-availability of quality insecticides, dominance of intermediaries, and lack of storage facilities were the major problems for mango cultivation.

BARI 8

Profitability and Technical Efficiency of Turmeric Farming: Evidence from Khagrachari District

Turmeric production plays an important role for income generation of the hilly people. It requires comparatively less capital investment for its production, grows with comparatively less use of fertilizer, and adoption of simple technology. But socioeconomic evaluation and documentation on its cultivation in hilly areas is scarce. Therefore, the study estimated the profitability and technical efficiency of turmeric farming in Khagrachhari district. In total 150 turmeric farms located in Khagrachari Sadar, Panchari and Matiranga Upazila of Khagrachari district, were surveyed to study their profitabilities and technical efficiencies. Data were collected, using a pre-tested questionnaire survey during January, 2015. The study revealed that turmeric farming is a profitable farming with some dominating variable costs like seed (rhizome) and sowing, harvesting and carrying. As the net return was Tk. 112139 per hectare and the BCR of sampled farmers was 2.20, this indicates that turmeric farms with a BCR greater than 1 have greater benefits than costs as well as positive net benefits. Seed (rhizome) and fertilizer showed significant positive effects on the turmeric production in the stochastic frontier production model. Turmeric farming displayed much variability in technical efficiency ranging from 44.2 to 95.2% with mean technical efficiency of 82%, which suggested a substantial 18% of potential output of turmeric can be recovered by removing inefficiency. Besides improving technical efficiency, potential also exists for raising turmeric production through higher education and extension services. For a land scarce country like Bangladesh this gain could help increase income and ensure better livelihood for the hilly farmers. The key policy implication of the analysis is that investment in education and extension service would greatly improve technical efficiency. Reducing fallow period from 3-5 years to 2-1 year/s has been deteriorating the hill farming environment. This resulted in unfertile land and fall in the production and productivity. Around 20% of the respondents took measures to control topsoil erosion. For that farmers planted fruits and other trees such as banana, pineapple, bean, pigeon pea, koroi trees etc.; and do mulch, line, drain for water flow.

BARI 9

Sunflower Cultivation in Selected Areas of Bangladesh: A Farm Level Study

The study was conducted in Bogra and Satkhira districts to assess the socioeconomic status of sunflower cultivation in Bangladesh. A total of 100 sunflower cultivating farmers, taking 50 farmers from each district, were randomly selected for this study. The highest 59% farmers cultivated sunflower because of its higher profitability than other crops. Per hectare cost of producing sunflower was estimated as Tk. 62,199. Per hectare net return and BCR were Tk. 15,282 and 1.25 respectively which indicated that sunflower cultivation was profitable. Stochastic frontier function revealed that the use of labour, seed, organic fertilizers, cost of irrigation, and land type had positive and significant effect on the yield of sunflower. Average technical efficiency of the farmers was 86% which implies that there is a scope of increasing productivity of sunflower by 14% using current level of inputs by increasing the farmers' efficiency. Lack of irrigation facility, scarcity of seed on time, absence of sunflower oil mill and sunflower market, low demand for sunflower, high cost of seed, etc. were the major problems of sunflower production and marketing. In spite of having some problems 18% female farmers became interested to cultivate and 46% farmers of Satkhira district mentioned that their demand for edible oil is becoming fulfil. So there is great potentiality of sunflower cultivation in Bangladesh. The availability of sunflower seed with low cost and establishment of sunflower oil mill is needed to sustain this crop in Bangladesh.

BARI 10

Adoption and Profitability of Maize Cultivation in Jessore Region

The study assessed the level of adoption and profitability of maize varieties at farm level. Data were collected 120 randomly selected maize farmers of Chuadanga and Jhenaidah district of Jessore region. The result indicated that Elite (34.17%) was highly adopted maize variety followed by Mirakkel (16.67%), Sunshine (11.67), 981(9.17%), Pacific (5.83%), NK-40 (6.67%), 92 (5.83%), 984 (5.00%), 87 (4.17%) and Uttoron (0.83%). The adoption level of irrigation, plant spacing were low, whereas seed sowing time and seed rate were medium and ploughing and laddering and seed sowing method were high. Farmer applied manure, urea, TSP, MoP, zipsum, zinc sulfate, boron, thiovit and DAP fertilizer in their field for getting higher yield. The

total quantity of fertilizer require was 1062 kg/ha of which urea, TSP, MoP, zipsum, boron, thiovit, DAP and zinc sulfate were 402 kg/ha, 240 kg/ha, 159 kg/ha, 116 kg/ha, 10 kg/ha, 13 kg/ha, 113 kg/ha and 10 kg/ha respectively. Total cost of production of maize was 126311 tk/ha where as 114811tk/ha is variable cost and fixed cost is 11500 tk per hectare. Among the cost item labor cost is the high as 43.04 % and fertilizer cost incurs 21.20 % cost of production. The average yield of maize was 10.14 ton/ha. The average gross return was calculated as Tk 177450 per hectare. The net margin of maize cultivation was 51139 tk/ha. On an average, benefit cost ratio was found to be 1.40 on full cost basis and 1.54 on cash cost basis. All the co-efficient of human labor, land preparation, manure, urea, MoP, zipsum, DAP, zinc sulfate and insecticide are positive and significant effect on maize production. Seed, TSP, boron, thiovit and irrigation had negative but significant impact on the yield of maize. Insect infestation mainly cutworm is the main problem in the maize cultivation. High price of seed and fertilizer is another problem faced by the farmer. The farmer had no marketing problem in the study area due to high demand of maize.

BARI 11

Adoption and Relative Profitability of Bari Chinabadam-8 and Dhaka-1 in Jamalpur and Sherpur District

The study was designed to assess the technological adoption and comparative profitability of BARI Chinabadam-8 and Dhaka-1 cultivation at farm level in selected areas of Jamalpur and Sherpur districts. A total of 120 farmers, 60 for BARI Chinabadam-8 and 60 for Dhaka-1 growers were selected for this study. Descriptive statistics with Cobb-Douglas production function model was applied for analyzing the primary data. The findings of the study revealed that BARI Chinabadam-8 and Dhaka-1 cultivation was highly profitable in which BARI Chinabadam-8 was more profitable than Dhaka-1 variety. The study indicated that per hectare gross return was significantly influenced by the use of human labour, seed, insecticide and irrigation. These factors were responsible for influencing gross return of both BARI Chinabadam-8 and Dhaka-1. Nevertheless, farmers were facing some problems and constraints in cultivating the groundnut in char areas of Jamalpur and Sherpur districts. These

problems included lack of quality seeds, irrigation facilities and shortage of financial capital.

BARI 12:

Production and Export Opportunities of Jara and Colombo Lemon from Bangladesh

The study was conducted in two districts namely Sylhet and Narsingdi to know the production technology of Jara and Colombo lemon growers, estimate profitability and identify the constraints of Jara and Colombo lemon. A total of 120 farmers taking 60 for Jara lemon from Sylhet and 60 for Colombo lemon from Narsingdi were selected randomly for the study. Data were collected through a pre-tested schedule during April-May, 2015. Cost return analysis revealed that Jara and Colombo lemon cultivation were profitable in the study areas. Jara lemon cultivation highest cost was estimated Tk. 413575/ha in (11-15)th year garden and lowest cost was Tk.365777/ha in 2nd year garden. Gross return was highest in 5th year garden (Tk.1995750/ha) and lowest Tk. 975600/ha in (11-15)th year garden. The benefit cost ratio at 6.5% rate of interest was 2.85and IRR 98%. Colombo lemon cultivation highest cost was estimated Tk. 316505/ha in 4th year garden and lowest cost was Tk.257543/ha in (11-15)th year garden. Gross return was highest Tk.841522 in 5th year garden and lowest Tk. 413616/ha in (11-15)th year garden. The benefit cost ratio at 6.5% rate of interest was 1.81 and IRR 124%. Lack of improved production technology, poor quality saplings, insect/pest infestation, adulteration of fertilizer and insecticides and less number of export buyers were found major constraints both Jara and Colombo lemon.

BARI 13

Constraints and Opportunities of Cut-Flower Production and Export from Bangladesh

Bangladesh has immense prospects for exporting cut-flowers to the world market. Although the share of export earning in cut-flowers is increasing day by day, its export is constrained by some barriers. Data relating to these issues are scarce in Bangladesh. Therefore, the present study was undertaken in Jessore and Dhaka district to examine the financial profitability, value addition and constraint of cut-flower production, marketing and export in Bangladesh. In total 170 respondents consisting 120 flower producers, 48 traders and 2 exporters were randomly selected and interviewed for the study. The BCR, NPV and IRR of rose cultivation were 1.46, Tk. 23,25,762/ha and 146% which indicated highly profitable to the farmers.

Again, the net return and BCR were Tk. 2,61,509/ha and 1.38 for gladiolus cultivation respectively. Farmer-cum-wholesaler, local traders, wholesalers, retailers and exporters were the main actors of cut-flower marketing and export. In rose marketing, the highest value addition (Tk.1.85/piece) was observed for retailer in Dhaka and the lowest (Tk.0.70/piece) was for local traders (*faria*) in Jessore. In gladiolus marketing, the highest value addition (Tk.3.02/stick) was also observed for retailer in Dhaka and the lowest (Tk.0.88/stick) was for local traders (*faria*) in Jessore. The growth rate of export earnings from cut-flower during 2008-2009 to 2013-2014 was 14.4%. The exporting cost of rose in Japan markets was Tk.407/kg or Tk.13.56/piece and the net value addition was Tk.556/kg or Tk.18.53/piece. Despite such potentialities, cut-flower export faced various constraints such as high airfreight charge, insufficient cargo place, absence of refrigerated transportation, lack of improved packaging materials, and lack of quality flower as international standard.

BARI 14

Maize Supply and Demand Situations in Bangladesh: Policy Implications

Maize is introduced as a relatively new crop in the rice based cropping patterns of Bangladesh. But now maize is an important cash crop to the farmers. Beside this it contributes a larger share of poultry and fish feed mills as raw materials. Information regarding actual demand and supply situations of maize in Bangladesh is absent. No one can say about this. For this the present study was undertaken to quantify maize demand and supply along with its constraints towards strengthening maize subsector. Both primary and secondary data and information were used in this study. Secondary data were collected from BBS, DAE and research reports. The total area under maize cultivation is estimated to be 0.3 million hectares producing 2.2 million MT with an average yield of 7.0 t/ha during 2013. But in 1996-97 the yield of maize was only 2.48 ton/ha. Current maize yield in Bangladesh is unpleasant. Potential maize yield is assumed as 12.61 ton/ha where yield of winter and summer maize in 2013-14 is 7.14 and 5.98 ton/ha respectively. A large part of maize demand in poultry and fish feed mills are fulfilled through import especially from India. During the period July, 14-April, 15 total no. of L/C opened for maize import was 124 of which settled was 173 for importing 113683.5 ton maize. Storing cost of maize is Tk 14/ kg per year. Nationally 60% of imported maize are using for broiler

feed production and the rest are using for fish feed production.

BARI 15

Assessment of Production and Marketing of Latiraj (Bari Panikachu-1) in Jessore Region

The study assessed the profitability of latiraj (BARI panikachu-1) production and marketing in Jessore region. Data were collected from 60 randomly selected panikachu farmers in Jessore district and 45 traders where 30 from Jessore msrket and 15 from Dhaka market. The total quantity of fertilizer require was 2974 kg/ha of which urea, TSP, MoP, zipsum and boron were 1011 kg/ha, 1076 kg/ha, 629 kg/ha, 230 kg/ha and 28 kg/ha respectively. Total labor requirement was 910 man days per hectare. Other input material was land preparation cost was 7145 Tk./ha, seedling 37895 no./ha, manure 10000 kg/ha, insecticide cost 13044 Tk./ha and irrigation cost incur 25989 Tk./ha. Total cost of production of panikachu was 358966 Tk./ha where as 337966 Tk./ha was variable cost and fixed cost was Tk. 21000/ hectare. Among the cost item labor cost is the high as 50.69% and fertilizer cost incurs 17.43% cost of production. The yield of rhizome and stolon were 50 ton and 35 ton per hectare. The average gross return was calculated as Tk. 655000 per hectare. The net margin of panikachu cultivation was 296034 Tk./ha. On the average, benefit cost ratio was found to be 1.82 on full cost basis and 1.94 on cash cost basis. All the coefficient of human labor, seedling, urea, TSP and MoP were positive and significant effect on panikachu production. Manure, boron and zipsum application had negative but significant impact on the yield of stolon. Marketing cost of Faria, Bepari, Paikar and Retailer were 55.70 Tk./quintal, 239.46 Tk./quintal, 34.73 Tk./quintal and 201.86 Tk./quintal respectively. Net margin of different actors like Faria, Bepari, Paikar and Retailer were Tk. 279.30 /quintal, Tk.525.54 /quintal, Tk.165.27 /quintal and Tk.448.14 /quintal respectively. Insect infestation mainly prodonia caterpillar and foot rot disease were the main problem in the panikachu cultivation. About 95% farmer faced insect and disease problem at latiraj field. High price of input material was another problem faced by the farmer. The farmer had no marketing problem in the study area due to high demand of stolon.

BARI 16

Marketing and Value Chain Analysis of Ginger: A Study in Selected Areas of Bangladesh

The study was undertaken to determine marketing system, marketing cost, margin, efficiencies and to examine the value chain of ginger aiming to determine the value addition in different steps of ginger marketing. Primary data were collected from Nilphamari and Lalmonirhat depending upon the concentration of production and commercially marketing of ginger and consuming area Dhaka and Rajshahi. Data were analyzed using marketing margin, profit and efficiency ratio, and value addition. Four major marketing channels were identified for domestic produced ginger marketing. Channel-3 was the most important supply chain through which 48% domestic produced ginger reaches to consumers. Marketing costs for each 100 kg of ginger were estimated from Tk. 86.92 to 339.77 and marketing margin Tk. 674.00 to 1820.00, respectively for different intermediaries. Marketing margin and profit were the highest in retailer than those of other intermediaries. Out of four marketing channel, Channel-4 was more efficient than those of other channels. Six actors like; farmer, local trader, benaries, commission agent, wholesaler, retailer and consumer are identified who are involved in the ginger value chain. The study revealed that farmer added the highest amount of value Tk. 2062.00 per 100 kg ginger followed by retailers (Tk. 1820.00), Benaries (Tk. 835.00), local trader (Tk. 690.00) and wholesalers (Tk. 674.00) respectively. Eleven marketing problem were identified, among them price fluctuation, high transport cost and lack of loan facilities were the major problem. It is therefore, recommended that loan facilities should be provided to the intermediaries, IT service should be developed up to village level and transportation cost should be keep reasonable

BARI 17

Import and Export Parity Analysis of Selected Vegetables and Spices in Bangladesh

The study was undertaken to find out the export potentialities of selected vegetables and import substitution of selected spices in Bangladesh. Seven hundred twenty vegetables and 320 spices growers, 25 suppliers, and 25 exporters were randomly selected for the study. Net margin analysis was done on both variable and total cost basis. Domestic resource cost (DRC) analysis was also done for estimating comparative advantage of the selected vegetables and spices. The study revealed that net returns were

positive for all vegetables and spices producers. However, the highest net return was estimated for brinjal producers (Tk 273799/ha) followed by bitter gourd producers (Tk 152145/ha). In the case of spices, the highest net return was received by ginger producers (Tk 231399/ha) followed by onion producers (Tk 122308/ha). Comparatively low net returns were found for okra (Tk 51830/ha) and garlic producers (Tk 99352/ha). Vegetables exporters received the highest net margin (Tk 32852/ton) from UK market which was higher than the Middle East market (Tk 22869/ton). The highest benefit cost ratio (BCR) was calculated for brinjal (1.9) followed by ash gourd (1.8). For spices, it the estimated BCR were 2.1 and 1.8 for ginger and garlic respectively.. Bangladesh had comparative advantage of producing all selected vegetables and spices as the estimates of domestic resource cost (DRC) were less than one. The value of DRC for all selected spices was less than unity implied that the production of these spices would be highly efficient for import substitution.

BARI 18

Impact of Farm Mechanization on Potato Production and Labour Use Pattern in Some Selected Areas of Bangladesh

Mechanization in potato cultivation implies the use of various power sources and improved farm tools and equipment, with a view to reduce the drudgery of the human beings and draught animals. Studies on this issue are scarce in Bangladesh. Therefore, the study was conducted in three districts of Bangladesh during 2014-2015 to find out the effect of mechanization on productivity and labour use in potato cultivation. A total of 130 samples taking 75 samples from conventional and 55 samples from mechanized potato farms were selected randomly for the study. The findings revealed that the yield of potato under mechanized farms (22.60 t/ha) was higher than that of conventional farms (20.53 t/ha). Total cost of production was significantly higher for conventional farms. Gross margin was found to be higher for mechanized farms (Tk.1,29,937) compared to conventional farms (Tk. 1,38,777). Cowdung, TSP and MoP had significant positive effect on the yield of potato production under mechanized farms. On the other hand, human labour and irrigation had significant positive effect on the yield of potato production for conventional farms. Mechanized farm used less number of labours compared to conventional farm. Family

labour was mostly affected by the mechanization. Animal power and output have positive effect on labour requirement, while power tiller and input costs have adverse effect on labour requirement for potato cultivation. The probability of adopting farm mechanization was significantly influenced by experience, education, farm size, training on potato cultivation, organizational participation and extension contact. Lack of technical knowledge for all machines operation was mentioned as a major problem of mechanization in the study areas.

BARI 19

Impact of Hybrid Rice and Maize Seed in Cereal Production System in Bangladesh

The present study was undertaken on hybrid rice and maize seed production and marketing scenario, farmers' perception and efficiency of hybrid rice and maize producers. The goal of the project will be achieved after three years (2014-15, 2015-16 and 2016-17). In first year, data of 20 seed dealers and 200 farmers have been collected and analyzed from Dinajpur and Sherpur on hybrid rice. In addition, data of major 10 seed companies have been collected and analyzed. More than 4 thousand tons of hybrid rice seed have been imported by the 10 seed companies in 2014-15 which is about 40% of total import of hybrid rice seed (about 10000 tons). All the seed companies sale their seed through distributor, seed dealers and retailers. Only BADC (SL 8 H) produce hybrid rice seed but it is not more than 10% of total import. Farmer's gross return and gross margin have been increased using hybrid rice seed compared to HYV rice seed. Gross margin was 22% higher in Dinajpur and 28% in Sherpur using hybrid rice seed over HYV seed. The results of stochastic frontier production function (SFA) indicated that translog production function was preferred and the parameter γ and σ^2 of the maximum likelihood estimates are significant which means that inefficiency effects are present in the analysis and the traditional "average" production function is not an adequate representation of the data. Hence, technical inefficiency effects have significant impact on output. These results suggest that there is a substantial scope for increasing hybrid rice production in the country using hybrid rice seed. Farmers are happy by producing hybrid rice varieties as they are higher yielder. Most of the farmer's opinion is, if per kg price of rice increase, then area of hybrid rice will be increased.

BARI 20

Assessment of Climate Variability Stresses, Adaptation Strategies and Capacity of the Farmers in Selected Coastal Areas of Bangladesh

Climate change and climate variability causes different biotic and abiotic stresses on crops and farmers' livelihood. Coastal farmers adopted various adaptation strategies to reduce these adverse effects. Data and information regarding these issues are scarce in Bangladesh. Therefore, the study was conducted in Patuakhali and Pirojpur district during 2014-2015 to identify climate variability stresses; evaluate adaptation system and capacity of the farmers to reduce different stresses effect; find out the factors that determine the adaptation capacity of the farmers; and identify the problem of adaptations. A total of 120 farmers taking 60 from each district were selected randomly. The study revealed that draught (100%) and uneven rain (100%) were the severe stresses in the study areas. Farmers responded that 62% crop loss occurred due to flood followed by water salinity (51%) and soil salinity (35%). Yield differences between adverse climatic condition and normal climatic condition were ranged from 40 to 78 percent. Education, family members, availability of credit facilities, and training were the significant determinants of adaptation capacity of the farmers. In order to adapt adverse situation, farmers adopted different measures like reserve rain water (13%), make ring well (11%), use of salt tolerant variety (34%), irrigation (22%), develop drainage system (49%), use pesticides (100%), use insecticides (100%), and temporary migrate/ switch to other occupation (75%).

Bangladesh Rice Research Institute

BRRI 1

Farm Level Evaluation of Modern Rice Cultivation in Bangladesh

BRRI dhan28 and BRRI dhan29 were the most popular varieties in Boro season. These two varieties covered about 64% of the total Boro area. BR11 and BRRI dhan49 were the most popular varieties in T. Aman season covering 20% of total T. Aman area. In Aus season, the area coverage of BRRI dhan28 was the highest (19.15%) followed by BRRI dhan48 (7.19%). Among BRRI varieties, BRRI dhan29 was the top yielder in Boro (5.71 t/ha) followed by BRRI dhan58

(5.50 t/ha). In T. Aman Season BRRI dhan49 ranked top in terms of per unit yield (4.79 t/ha) followed by BRRI dhan46 (4.73 t/ha). In Aus season BRRI dhan29 also gave higher yield (5.02 t/ha) followed by both BR16 and BRRI dahn48 (4.40 t/ha). Recently, some Hybrid varieties are being adopted as replacement of other MVs in Boro and Aus seasons due to higher yield performance. Farmers faced constraints like higher wage and irrigation cost, non-availability of quality seeds and lower market price of their product.

BRRI 2

Estimation of Costs- Return, Factor and Income Shares of MV Rice Cultivation at Farm Level

Rice farmers are still using more seeds than the recommended rate, irrespective of cropping seasons. Although, they used higher dose of Urea, they applied comparatively very lower amount of MP fertilizer, may be due to their ignorance. MV Boro growers obtained higher yield due to better cropping environment, good management practices and use of better genotypes. Rice farmers received comparatively lower amount of gross return from MV Aus and MV Boro owing to lower market price. MV T. Aman growers received higher net return due to better market price. Factor and income shares analysis revealed that the human labour contributed the highest effort to the production process; and, on the other hand, farmers earned the highest share of income among all other production participants. We have opportunities in rice production but not risk or threat free.

BRRI 3

Crop Land Shift into Mango Orchard: Causes, Impacts and Profitability under New Farming Systems in Barind Area of Bangladesh

Although, mango cultivation required huge cost initially, received higher net return compared to other crops which is the main reason of shifting their crop land to mango orchard. Besides, farmers' attitudes toward area substitution for mango orchard seemed to be very positive due to water scarcity, high profitability, easy cultivation process, land suitability and favorable environment for mango cultivation. Mango cultivation has positive impact to household income and livelihood patterns. Mango farmers experienced different constraints such as diseases and

insect's infestation, lack of training, credit and marketing facilities.

BRRI 4

Impact Assessment of Seed Production and Demonstration Program (SPDP) on Quality Seed and Rice Production

All categories of farmers were familiar with demonstrations like production and dissemination of seeds earlier, were included in SPD program. Variety selection was not quite accurate in Khulna as long duration and coarse grain varieties were demonstrated in this district. Farmers of Khulna district were not interested to preserve seed as foundation seeds were available.

BRRI 5

Value Chain Analysis and Share of Different Actors in Rice Marketing Channel in a Selected Area of Bangladesh

Value chain analysis indicated that the miller captured the highest net margin (45%) followed by the retailer (15%) and wholesaler (13%). On the other hand miller and wholesaler shared the highest marketing cost (52% and 15%) among the actors of the rice supply chain. Overall net margin /profit of the supply chain of rice was more than half (58%) of the gross margin, which is not justifiable in the context of a developing economy like Bangladesh; although, the actors of the channel performed varieties of facilitative functions. The rice market structure should be guided to transitional value chain of less intermediaries' actor-involvement. Each of the actor's roles should be valued as per their contribution in value addition.

BRRI 6

Impact of Climate Change on Rice Production in Bangladesh

Bangladesh is severely vulnerable to the impacts of climate change, due to its geographic location; flat and low-lying topography; dense population; high poverty; reliance of livelihoods on climate sensitive agriculture. Under this situation the production of *Aman* and *Boro*, is increasing and thereby boosting up the aggregated production of rice; although, the trend of production in *Aus* season is declining. Thus, the total rice production will be increasing up to 2030; and,

afterwards this trend will be downward moving. The increasing trend in production eventually augmented the volume of stock of rice, in one hand; and on the other, declining the quantum of imports. Negative income elasticity indicating strong substitution effect, confirms the changing food habit of the consumers'. However, total demand for rice will increase as population is increasing.

BRRI 7

Forecasting of Foodgrains Area and Production in Bangladesh: A Univariate Time Series Approach

Analysis indicated that ARIMA (3, 1, 1), ARIMA (4, 1, 2), ARIMA (2, 2, ma(9)) and ARIMA (2, 1, 4) were the best fitted model for short run forecasting of Aus, Aman, Boro rice and wheat production, respectively. On the basis of the fitted models, production of Aus, Aman, Boro and wheat would be 2330, 14235, 18809 and 1698 thousand tons, respectively by the year 2022-23. On the other hand best ARIMA models for area of Aus, Aman, Boro and wheat were (2, 1, 2), ARIMA (3, 1, 1), ARIMA (2, 1, 2) and ARIMA (3, 1, 2) which forecasted that area of those crops would be 557, 5628, 5698 and 515 thousand ha, respectively by the year 2022-23.

BRRI 8

Projection of Irrigation Cost over Next 10 Years by Using ARIMA Models

Irrigation cost is increasing continuously due to higher costs of fuel, electricity and labor. The projected irrigation cost would be 20% and 19% higher by the year 2024 for STW and DTW, respectively. Irrigation cost could be minimized by improving farm water management practices. So, policies should be taken to promote water management practices.

Bangladesh Sugarcane Research Institute

BSRI 1

A Study on Production and Marketing of *Goor* in Selected Areas of Bangladesh

The comparative study between *goor* production and supply cane to sugar mill shown that *goor* production was more profitable than supplying cane to mill. The farmers are more interested to produce *goor* or sale sugarcane to the *goor* maker. Per hectare yield of

sugarcane production in mill zone and non mill zone area were 50 and 55 ton respectively. Average sugarcane production cost in mill zone was Tk.1,15,910/ha and total return was Tk. 98,550/ha. A farmer when he sales his product then he received more returns (Tk. 1,33,950/ha). Benefit cost ratio achieved from sugar mill and *goor* maker are 1.35 and 1.63 respectively. On the other hand, production cost and total return of a *goor* farmer was Tk. 1,65,000/ha and Tk. 2,47,000/ha respectively. Benefit cost ratio of a *goor* farmer was 1.50. The benefit cost ratio of a *goor* maker was 1.38. Production cost of *goor* farmer and *goor* maker is Tk.30.00/kg and Tk. 36/kg respectively. There are many intermediaries in *Goor* marketing. On the basis of the intermediaries six marketing channel were identified as a dominant. The *Goor* farmer/*Goor* maker – Bepari – Arratdar - Paikar - Retailar - Consumer was identified as a most dominant channel and 25 percent of the product runs through this channel. About 90% farmers hired van and bi-cycle or rikshaw to carry their *goor* in the market. The retailers incurred the highest cost which were average Tk.60,000/ton. There is many problems of *goor* farmers and intermediaries. Among them Lack of adequate knowledge to produce hygienic *goor* is an important problem. Storage facility of *goor*, transport facilities etc., are the others issue. The farmers are not trained to prepare a hygienic *goor* and preserve properly those *goor*. The study suggested to create facility to storage *goor* and established the organization of *goor* board to solve problems of *goor* farmers.

BSRI 2

Economic Study of Subsidy use in Sugarcane Production in Bangladesh

Due to subsidy programme the additional increase of sugarcane yield and income was 13.30 ton ha^{-1} and Tk. 35,630.70 ha^{-1} respectively. Per hectare average amount of subsidy was Tk. 8336.25 and as a result the net income came out Tk.27,294.45 ha^{-1} through subsidy programme. Additional sugar productions in 2003-04, 2004-05, 2005-06, 2006-07, 2007-08 and 2008-09, 2011-12, 2012-13 and 2013-14 cropping year were 1385.43, 5881.85, 10847.00, 9641.37, 3922.29, 8576.36, 9578.78, 11013.67 and 6329.63 ton respectively due to subsidy programme. Domestically we are not self- sufficient in sugar production. Every year we have to import sugar to meet up our increased demand. In 2013-14 the market price of 6329.63 ton additional sugar is Tk.265.84 million. Additional sugar production due to subsidy programme is saving our

hardcore foreign exchange because. Benefit cost ratio of sugarcane production under subsidy programme in 2003-04, 2004-05, 2005-06, 2006-07, 2007-08, 2008-09, 2011-12 and 2013-14 cropping year were 4.28, 5.08 3.51, 2.87, 1.20, 3.15, 4.76 6.43 and 4.27, respectively.

Bangladesh Institute of Nuclear Agriculture BINA 1

Value chain analysis of oilseed varieties Binatil-1 and Binatil-2 in some selected areas of Bangladesh

The study was conducted at Mahammadpur upazila of Magura, Chaugasa Upazila of Jessore and Daulatpur Upazila of Kushtia for Binatil production and local market survey and Siddique Bazar of Dhaka were selected for urban market survey. The objectives were i) to estimate the cost and return of Binatil-1 and Binatil-2, ii) To identify the value chain of Binatil-1 and Binatil-2 iii) To determine the constraints in cultivation of Binatil-1 and Binatil-2 and iv) to suggest recommendations for policy guidelines. A total of 130 respondents, 90 for Binatil-1 and Binatil-2 producer and 40 for traders were selected as sample size. Besides two khaja producing mill one at kumarkhali upazila from Kustia and other at savar (Nabinagar) from Dhaka were also selected to conduct present study. Finally, choto bazar of Mymensingh district was also surveyed for knowing Binatil oil situation. In case of Binatil-1 producer share was 65 percent for value chain-I (Farmer > Faria > Bepari > Paiker > Urban Aratdar > Processor > Company agent > Consumer) and 55 percent for value chain-II (Farmer > Faria > Bepari > Paiker > Urban Aratdar > Processor > Hawker > Consumer) and it was 63 and 56 percent respectively for Binatil-2. It was also observed that price spread was lower and producer share was higher in marketing chain-I than the marketing chain-II. So marketing chain-I is more efficient than marketing chain-II.

BINA 2

Adoption and impact of salt tolerant rice varieties (Binadhan-8 & Binadhan-10) cultivation among the coastal areas of Bangladesh.

The study was conducted in coastal areas of Bangladesh, namely Patuakhali, Cox's Bazar, Chittagong, Bagerhat and Khulna. A total of 250 farmers were randomly selected as sample size by using multistage sampling method in the study area. The respondent farmers in the study areas usually using

higher inputs in cultivating Binadhan-10 compared to Binadhan-8. The average cost of production of Binadhan was tk. 58874.81. The highest share of the total cost was for human-labour and irrigation in cultivating both varieties. The adopting farmers spent more on land preparation, fertilizer and pesticide. Per hector net return received by adopting farmers was Tk. 22571.51, and it was higher in the case of Binadhan-8 (Tk. 24915.37). Irrespective of the study areas the average yield of Binadhan-10 (5.2 t ha^{-1}) was higher than Binadhan -8 (4.9 t ha^{-1}). But due to higher cost in human labour, land preparation and fertilizer than Binadhan-8, the average net return was lower in the case of Binadhan-10 (Tk. 20227.64 ha^{-1}). The overall rate of return was 1.37 indicates that cultivation of these variety is profitable to the farmers when all sorts of cost were taken into consideration. The study found that adoption level of seed rate was high among the study areas but farmers often do not follow recommendations for applying fertilizers. All the sample farmers in Patukhali district applied urea, TSP, and MoP in higher quantity compared to their recommended doses. Therefore, according to adoption index, the level of adoption for applying fertilizer is over use. In case other districts farmer using either in excess or in small quantities of fertilizer. The highest area coverage was in Cox's Bazar district, 3.70 percent in term of total cultivated area and 4.58 percent in term of total soil affected areas followed by Satkhira (2.40 & 1.11 %), Bagerhat (2.40 & 1.03 %) and Khulna (1.53 & .61 %), respectively. This figure indicates that area coverage among the coastal areas is not satisfactory. Therefore more extension program is needed to bring extra area under salt tolerant varieties cultivation.

Participation in the Training, Workshop, Seminar, Training-workshop etc (Local)

All personals attended in many Trainings, Workshops, Seminars, Training-workshops etc (Local) organized by different organizations. Dr. A.S.M. Anwarul Huq, MD supervised 2 students of Sher-e-Bangla Agricultural University: 1. Rashedul Haque on the title Technical Efficiency and Profitability of Onion Production in Selected Areas of Bangladesh, and 2. Rezoyana Kabir Rasha on the title Productivity and Resource Use Efficiency of Shrimp (*Penaeus monodon*) Farming in Some Selected Areas of Khulna District in Bangladesh.

COMPUTER AND GIS

The major responsibilities of Computer and GIS unit is to manage overall Information and Communication Technology (ICT) related activities in terms of hardware, software, networking etc. The ultimate goal is to establish BARC as information hub of NARS so that overall agricultural research system becomes strengthened and robust in terms of information availability, accessibility, dissemination etc. resulted to ensure good governance in this sector. The unit plays a vital role to establish/strengthen ICT infrastructure to facilitate MIS related activities/services among NARS institutes. The activities also involved in preparing technical specification for procurement of computer hardware, software, networking and related goods/accessories, evaluating technical proposal, receiving and distributing ICT goods etc. The unit also provides support for troubleshooting of hardware, software, network, internet/email and related services for smooth running of the system. In addition to that, it conducts various ICT based training, workshop, seminar for the personnel of BARC and NARS institutes for capacity building. Besides, the unit conducts a lot of other activities such as preparation of progress report, need assessment, review and evaluation of research program, recruiting of computer personnel etc. Personnel of the unit are also working as innovation officer and member of innovation team of BARC formed under Governance Innovation Unit (GIU) of Prime Minister's Office.

Geographic Information System (GIS) is another important functional part of the unit. Maintenance, necessary updating and output preparation of AEZ land resources database and local level Upazila Nirdeshika database (soil, land, nutrition and others) is an on-going activity of this unit. Land suitability assessment and crop zoning was an important outcome of GIS activity.

With the support of National Agricultural Technology Project (NATP) phase-I, Computer and GIS unit established a Data Center at BARC which connects 7 NARS institutes through Virtual Private Network (VPN). During 2014-15, MIS has been deployed at

BARC Data Center as well as at 7 (seven) NARS institutes. MIS software related activities such as data input, validation, testing etc. were going on at each organization towards making the MIS fully operational. The MIS system once operational will help managing human resources, identify skill gap, observe research trend in different sub-sector of agriculture, avoid wasteful duplication, maintain account and budgetary system, procurement among many other advantages. The unit has developed some online databases and related services which are accessible through BARC website. The unit has also provided strategic and technical support in establishing the National Agricultural Display Center (NADC) at BARC. During this period actively involved in preparation of ICT need assessment of NARS for NATP, Phase-II. Accordingly, ICT equipment, software and apps, training and other requirements including their budget were finalized with justifications and submitted to World Bank.

Major activities of Computer and GIS Unit

The personnel of Computer & GIS Unit accomplished the following activities during the period from July 2014 to June 2015:

Data Centre Operation

The proper functioning of data centre is very crucial in the context of accessibility to MIS databases, email and internet service, and other relevant services through



Data Centre at BARC

local area network (LAN), virtual private network (VPN). Subsequently, the personnel of the unit performed the activities for proper functioning of hardware, software and network system for smooth

running of Data Centre. The part of the activities are file server, domain server, database and application server management, file sharing, data backup and other relevant tasks. The unit also taken necessary measures to ensure proper functioning of antivirus for safeguarding of computer server and desktop/laptop under LAN and online backup system (UPS), cooling system etc. The proper maintenance and operation of data centre is very much essential for providing services to various users with their information requirement.

Establishment of MIS-ICT facilities at NARS

The main responsibility under this activity was to provide required support for the development, deployment and operationalization of MIS (9 modules) at BARC and NARS institutes. Accordingly, the MIS has been deployed in 7 NARS institutes and BARC. Afterwards, data entry into the system started and while carrying out this activity, some bugs were identified. Consequently, Computer and GIS unit provided support to Project Coordination Unit of NATP and MIS development firm (Techno Vista Ltd.) in compilation of bugs, prioritizing them and making schedule for fixing the bugs. Also, necessary support has been provided for remotely access to server of BARC Data Centre by Techno Vista Ltd. through TeamViewer client to deploy the updated version of MIS. The unit arranged training on MIS modules for expediting data input activities into the system. Personnel of different disciplines of BARC and NARS institutes participated in the training programs. Relevant support provided to NARS particularly BARI in operationalization of some modules of MIS and supervised data entry and validation activities of BARC.

PROJECT DEVELOPMENT

Project proposal titled *Development of Upazila Land Suitability Assessment and Crop Zoning System* was prepared and submitted to KGF for funding. It will include 300 upazilas of Bangladesh during the proposed 3 years duration of the project.

Actively worked in the committee formed by Crops Division to develop a project proposal entitled

Strengthening of Food Security Information System and its Networks among BIMSTEC Member States (BIMFSIS).

PROJECT IMPLEMENTATION

Application of GIS for farm productivity enhancement through land suitability assessment of major cropping pattern of Bangladesh (SPGR Sub-project): A training was organized on the crop suitability assessment model (CSAM) software. Twenty participants from BARC and NARS institutes participated in the training program. Project Completion Report (PCR) is prepared and published, and the report submitted to PIU of BARC, NATP Phase-1. The project completed in November 2014.

Establishment of Agricultural Technology Information Network (ATIN) in Asia: During this period e-content of agricultural production technologies of 25 crops were developed and uploaded to AFACI website. Also, crop calendar for 5 (five) crops boro, aus and aman rice, wheat and mustard have been published and distributed to DAE, relevant NARS institutes and other organizations, and uploaded to website. As an important activity of the project an annual evaluation workshop of AFACI projects in Bangladesh has been organized during this period.



Annual evaluation workshop of AFACI projects in Bangladesh

Capacity enhancement of NARS through ICT-based Agricultural Research Management Information System (ARMIS) project: In ARMIS project, revised proposal for 2nd phase was prepared and submitted to KGF. After approval of the 2nd phase, recruitment of 15

personnel including Technical Coordinator, Agriculture Expert, Programmer, Research Associate, Data Encoder, Office Assistant and Office Helper is done. Also, renovation of office room, procurement of office equipment, stationeries, computers, AC etc. is completed. Arranged national workshop, joint meetings at BARC, training workshops at BARI, BJRI, BINA, BFRI (forest), and special seminars at BARI, BRRI, and BLRI. During this period, a user manual of the ARMIS application is prepared and a project brochure is published and distributed among NARS, universities and other stakeholders. Also published ARMIS news in newspapers named Krishi Projukti and Daily Somokal. The number of research entry, edit and verification during this period were 11,102 from about 140 organizations (including journals). The total number of research information available in the database till June 2015 was 17,402. In addition, 2nd version of ARMIS software was developed during this period considering the sustainability of the application.



POLICY LEVEL CONTRIBUTION

Prepared several ICT related reports/documents required by the ministry of agriculture such as opinion on Cyber security law-2015. Provided comments to the ministry of agriculture on the MoU concerning Asian Micro-Satellite Consortium (AMC). Prepared two article for text book of secondary school level on (i) Crop zoning and (ii) Use of ICT in agriculture.

Monitoring, reviewing and evaluation of programs of NARS institutes

Field monitoring of programs/activities

As a team member of monitoring team formed by Planning & Evaluation division of BARC, Mr. Hasan

Md. Hamidur Rahman, Senior System Analyst, monitored the implementation progress of core research programs (i) *Studies and Development of IPM strategies for plant parasitic nematodes in tea* at BTRI, Moulvibazar (ii) *Validation and Dissemination of Newly Developed Rapeseed-Mustard Varieties in the High Land and Haor Ecosystems in Sylhet Region* (iii) *Yield gap minimization of Boro rice in the haor areas through agronomic management with special reference to fertilization* and (iv) *Development of artificial breeding techniques of Sperata aor* under BARC research grant at Moulvibazar.

Review of Research Program

Mr. Md. Abeed Hossain Chowdhury, Director, Computer & GIS unit attended in the internal review of annual research and program planning workshop of ASICT division of Bangladesh Agricultural Research Institute (BARI) as expert scientist. He has provided valuable comments and feedbacks for the improvement of future research programs of ASICT division.

Evaluation Report

Mr. Md. Abeed Hossain Chowdhury, Director, Computer & GIS unit evaluated 4 (four) research proposal submitted for core research funding by BARI and BAU. The programs were (i) Information of BARI technology at farmers' doorstep through mobile apps (ii) Development of agricultural geodatabase in the Haor region for sustainable intensification (iii) Impact of improved agricultural technologies on sustainable crop productivity in Teesta Barrage project area – a remote sensing and GIS-based analysis emphasizing land use, soil fertility and (iv) Climate change scenarios and development of a database of last 40 years research in the field of agricultural engineering in Bangladesh and accordingly provided comments on the technical and financial aspects of the project proposal.

Database Development

During this period, analysis and design of agricultural technology database has been completed. Agricultural

technologies developed by NARS and other organizations will be incorporated in the technology database. Also several database application and services were developed during this period. These are (i) Climate Database (new version), (ii) Online booking system for managing BARC resources like conference room, auditorium, training room etc. and (iii) Web applications for accessing land resources information, maps and shape files, crop calendar, report on user's usage record for above database application and services.

Maintenance and Updating of BARC Website

The work is being carried out as a routine job. BARC website is anchored with the national web portal and updated regularly. Both Bengali and English version of the website is available in the portal. Many web pages were translated from English to Bengali and uploaded into the website. Also technical support provided to BTRI to formulate and anchoring their website to national web portal.

Climatic database

The daily climate data (temperature, rainfall, humidity, sunshine, wind speed, cloud coverage) from 2010 to 2013 collected from BMD. The daily data were then collated and entered into the database system. After necessary correction the data were analyzed and the outputs were available in the form of monthly and historical average under different scenarios.

The Essential Electronic Agricultural Library Facilities

The Essential Electronic Agricultural Library (TEEAL), a full-text, searchable digital library of articles from high-quality research journals in agriculture and related life sciences was installed at BARC data centre. The TEEAL service is accessible to all users of BARC and NARS through LAN and VPN.

Continuation of GIS Activities

The land resources information of 11 (eleven) upzilas of Upazila Nirdeshika database were used in SPGR

sub-project titled "Application of GIS for farm productivity enhancement through land suitability assessment of major cropping pattern of Bangladesh". Several maps were prepared and printed for displaying at National Agricultural Display Centre.

The information on soil, land and climatic properties of AEZ Tista floodplain has been prepared and provided for project formulation.

Support to BARC and different component of NATP as PEC and TEC member

Necessary support has been provided to BARC and NATP for procurement of goods, works and services. Also involved in various recruitment at different organizations/projects.

Support to divisions/sections of BARC for hardware/software/network/Internet; data analysis; multimedia presentations; Information sharing and resource management

Support provided to different divisions/sections to fix various types of computer hardware and software problems. Several types of maps, land resources, climatic and other data have been provided to scientists/researchers/extentionists as per requirement.

Support for planning, budgeting and procurement of computer resources (hardware, software & accessories etc.)

Support provided in the form of requirement assessment, specification preparation, budgeting for procurement of computer hardware, software and accessories to BARC and different projects i.e. ARMIS, NATP and KGF.

Innovation Team activities

Innovation team is formed at BARC according to the gazette of Bangladesh government. There are 6 members from different divisions/sections of BARC. Computer and GIS unit organized a workshop on "Service innovation through ICT" at BARC where NARS institutes were also participated. During this period, service innovation work plan-2015, progress

report of BARC activities according to ICT Act 2015 were prepared and sent to MoA. Information of innovation team and its activities were uploaded to BARC website under the menu Innovation as per guideline of MoA. Usage of email, website etc. related guideline sent to all officers of BARC for their awareness development. Attended several monthly innovation meeting arranged by MoA.



Activities of Service innovation through ICT

Other activities:

National Agricultural Display Centre (NADC):

National Agricultural Display Centre (NADC) is established at BARC complex. During this period, the personnel of Computer and GIS unit performed many activities for establishing NADC. The activities include supervision of the setup of NADC (digital part), coordination with NARS institutes for supplying of specimen to be displayed at NADC, conversion and setup of video documents in the server etc. Also, the unit developed an application to store detailed description of specimen, technology etc. of BARI and BRRI, coordinated with the supplier company (TVSL) for smooth operation of digital components, supervised and performed activities related to inauguration of NADC. Participated in the meetings and helped formed committees to establish and run the NADC smoothly and played a vital role in those committees.

Application Hosting to National Data Centre (NDC) at Bangladesh Computer Council (BCC)

Computer and GIS unit created 7 (seven) sub domains like www.lri.bacapps.com; www.maps.barcapps.com;

www.cropzoning.bacapps.com; www.climate.barcapps.com; www.armis.barcapps.com; www.cropcalender.barcapps.com and www.pds.barcappsgov.bd in National Data Centre (NDC) of BCC. During this period, 7 database application and services of BARC hosted in NDC using the mentioned sub domains.

Support to Installation and commissioning of BanglaGovNet network at BARC

Under BanglaGovNet project of Bangladesh Computer Council (BCC), a network connection established at BARC to be connected with countrywide network infrastructure among government offices. As part of this activity, 8 Mbps network bandwidth is provided and 3 IP telephony set is installed at BARC.

Digital Signature, SSL and eGP

Performed activities related to Digital Signature, such as filling up registration form and sending to Planning Commission. Performed activities related to SSL certificate of BARC website and sent to Planning Commission. Performed activities related to BARC's inclusion of e-Government Procurement (eGP) portal, filling up registration form and sending to Planning Commission.

Participation in Digital World 2015

Two personnel of Computer and GIS unit Mr. Shohid Uddin Bhuiyan, System Analyst and Mr. Mihir Kanti Sarkar, Data Entry Officer participated in the Digital World 2015 fair as exhibitor. Online crop calendar, Crop zoning maps with information and Climate database were exhibited in the Digital World 2015 held at BICC, Dhaka on 9-12 February 2015.



II. HUMAN RESOURCES DEVELOPMENT

Crops

Training on Knowledge and Awareness Building on Agricultural Policies of Bangladesh

A 3-day training workshop entitled “Knowledge and Awareness Building on Agricultural Policies of Bangladesh” on May 5-7, 2015 at the BARC Training Building in Farmgate, Dhaka by Crops Division, BARC organized. A total of 40 participants were selected to attend from different National Agricultural Research System (NARS) organizations, including the Department of Agricultural Extension (DAE), Bangladesh Agricultural Development Corporation (BADC), Seed Certification Agency (SCA), Bangladesh Agricultural Research Institute (BARI), Bangladesh Rice Research Institute (BRRI), Bangladesh Institute of Nuclear Agriculture (BINA), Bangladesh Sugarcane Research Institute (BSRI), Bangladesh Jute Research Institute (BJRI), Cotton



Development Board (CDB), Soil Resource and Development Institute (SRDI), Bangladesh Sericulture Research and Training Institute (BSRTI), Bangladesh Academy of Rural Development (BARD), Ministry of Agriculture (MoA), Bangladesh Institute of Research and Training on Applied Nutrition (BIRTAN) and Bangladesh Agricultural Research Council (BARC).

The training workshop started with a welcoming address given by Dr. Mian Sayeed Hassan, Director of the Technology Transfer & Monitoring Unit (TTMU), BARC and the coordinator of this training workshop. The training workshop was inaugurated by the Chief Guest Dr. Abul Kalam Azad, Executive Chairman of BARC. Twelve papers were presented during the workshop. The topics of these papers included:

- Agricultural Research in Bangladesh: Priorities, Challenges and Opportunities
- Sixth Five-Year Plan: Strategies for Raising Productivity and Agricultural Growth
- National Agricultural Policy, 2013
- Agricultural Extension Policy and Technology Transfer System in Bangladesh
- National Seed Policy, 1993
- Fertilizer (Management) Act, 2006
- Minor Irrigation Policy
- National Bio-safety Guidelines & Rules
- Food Safety Act, 2013
- Plant Quarantine Law
- National Crops and Forest Biotechnology Policy Guidelines
- Bangladesh Climate Change Strategies and Action Plan.

After the presentation of each topic, there was a lively discussion. The participants thanked the BARC authority for organizing an event for the scientists working in various NARS institutes. At the end of the training, participants received certificates from Dr. Azad.

Farmers Training and Field Validation Trial on Good Agricultural Practices (GAP) for Tomato

Field validation trials and farmers' training on Good Agricultural Practices (GAP) based on manual developed for tomato under the AFACI-GAP project was conducted. At the beginning of field validation on GAP a consultation meeting with a daylong training on tomato production technology and GAP was organized on 13 November, 2014, at Chandina, Comilla. The field validation trials were conducted in two separate villages at Chandina, an extensive tomato production area. Extension Officers, scientists (ORFD-Comilla), research assistants and 16 implementing farmers (having 10 decimal lands of each farmer) were participated in the training and consultation program. After completion of the training field visit was done for proper selection of the GAP trials in field. The principles and concepts of GAP as well as the activities to be done for implementing the GAP in field have been explained clearly in field also. Dr. Mian Sayeed

Hassan, Director, Technology Transfer & Monitoring Unit (TTMU), BARC and Principal Investigator (PI) of AFACI-GAP project organized and coordinated the aforesaid activates at different locations.

Farmers Training and Field Validation Trial on Good Agricultural Practices (GAP) for Mango

Field validation trials and farmers' training on Good Agricultural Practices (GAP) based on manual developed for mango under the AFACI-GAP project was conducted. At the beginning of field validation on GAP a consultation meeting with a daylong training on mango production technology and GAP was organized on 3 December, 2014, at Sibgonj, and 4 December, 2014, Bholahat, Chapainawbabgonj, the most extensive mango growing area. The field validation trials were conducted in 10 selected mango trees by 2-3 farmer's gardens in both locations. Extension Officers, scientists (RHRB-BARI, Chapainawbabgonj), research assistants and 20 implementing farmers were present the training and consultation program. After completion of the training field visit was done for proper selection of the GAP trials. The principles and concepts of GAP as well as the activities to be done for implementing the GAP in field have been explained clearly in field also. Dr. Mian Sayeed Hassan, Director, Technology Transfer & Monitoring Unit (TTMU), BARC and Principal Investigator (PI) of AFACI-GAP project organized and coordinated the aforesaid activates at different locations.

Training on Phytosanitary Measures and Food Safety Issues in Bangladesh

A training entitled *Phytosanitary Measures and Food Safety Issues in Bangladesh* was organized during 07-08 June 2015 through Revenue budget of BARC. This was the 4th batch of the training in this subject. The objectives of the training were to improve the knowledge and skills of scientists and officials, dealing with phytosanitary and food safety issues in the country. A total of 40 scientists and officers from NARS institutes (BARC, BARI, BRRI, BJRI, BSRI, BINA, CDB, BSRTI), BADC, DAE, SCA, BSTI, Hortex Foundation, BSMRAU, SAU and other NGOs (ACI Seed, BRAC, Lal Teer Seed Ltd., PRAN-RFL Group) was participated in the two day training.

Relevant specialists from BARI, SCA, Sylhet Agricultural University, DAE, BSTI, Hortex Foundation and BARC delivered lectures covering issues & policies of phytosanitary measures and food safety. Adoption of international standards of phytosanitary and food safety measures at different stages of crop production; processing, transport, marketing etc were highlighted in the training. Development of national Maximum Residue Limits (MRLs) was emphasized by MRL experts to initiate a project proposal for the development of national MRLs. Adoption of plant biosecurity measures were suggested undertaking at regular research programme and educational curricula. The feedback and recommendations of the training were considered for the development of future policy and strategies in order to reduce food adulterations for ensuring healthy nation.



Training activities on Phytosanitary Measures and Food Safety Issues in Bangladesh

Training on Agricultural Technologies for Adaptation to Climate Change

A two day long training programme was conducted during 10-11 June 2015 at BARC, Dhaka. The objectives of the training was to develop trained trainer on climate resilience technology. Total nine papers were presented during the training. These are- Impact of Climate Change in Agriculture, Climate Resilience Technologies for Rice Production, Climate Resilience Technologies for Sugar crop Production, Climate Resilience Technologies for Maize Production, Field Climate Resilience Technologies for Vegetable Production, Climate Resilience Technologies for Fruit Production, Climate Resilience Technologies for Sesame and Soybean Production, Climate Resilience

Technologies for Jute Production, and Climate Resilience Technologies for Wheat Production. A total of 09 important topics were delivered by the renowned speaker of the respective field. Forty participants from DAE, BADC, BARI, BRRI, BINA, BSRI, BJRI, CDB, BSRTI, SAU, BAU, SylAU, BSMRAU and BARC were attended the training course. Executive Chairman, BARC distributed certificates among the trainees.



Inaugural Session of Training on Agricultural Technologies for Adaptation to Climate Change

Review workshop on Crop Improvement Programme of NARS Institutes: Research Progress 2013-14 & Research Programme 2014-15

A two day long review workshop on “Crop Improvement Programme of NARS institutes” was held at BARC during 18-19 August, 2014. Dr. Md. Kamal Udin, Executive Chairman of BARC was present as Chief Guest where Dr. Abul Kalam Azad, Member Director (Crops) chaired the session. Dr. Md. Aziz Zilani Chowdhury, Chief Scientific Officer (Crops), BARC welcomed all participants to the workshop. Dr. Uddin gave special emphasis on the crop improvement programme for achieving high crop productivity and food security in the country. Four technical sessions covering Varietal Improvement through Conventional Breeding of Cereal Crops, Oilseeds and Pulses, Horticultural Crops (fruits, vegetables, spices, tuber crops etc), Varietal Improvement through mutation, Varietal Improvement through Biotechnological and Physiological approach were included in two day’s workshop. Scientists of BARI, BRRI, BINA, BJRI, BSRI, CDB and BSRTI (Bangladesh Sericulture Training and Research Institute) presented their research findings in the workshop. Prof. Dr. Md Abdul Khaleque Mian, Dept. of Genetics & Plant Breeding, BSMRAU, Prof. Dr. Lutful Hassan, Dept. of Genetics & Plant Breeding, BAU, Mymensingh, BARI, Gazipur, Dr. Abu;l Kalam Azad, Member Director (Crops), BARC, Prof. Dr. Md. Shahidur Rashid Bhuiyan, Pro-

Vice Chancellor, SAU, Dhaka and Dr. Md. Khalequzzaman A Chowdhury, Former MD (Crops), BARC chaired the technical sessions. They also provide expert opinion including Prof. Dr. Rakha Hari Sarker, Department of Botany, DU, Dhaka in two day long workshop.

Scientists of seven NARS institutes presented their research progress (2013-14) and research programme (2014-15) on crop improvement. Almost all major crops (rice, wheat, maize, oilseed, pulses, vegetables, fruits, tuber crops, spices, flower, jute, sugarcane etc.), cotton and Silkworm & Mulberry were included in the crop improvement programme. Proceedings prepared based on the comments and opinion made on the workshop and sent to the respective institutes for necessary actions.

Review workshop on Crop Protection Programme of NARS Institutes: Research Progress 2013-14 & Research Programme 2014-15

Review Workshop on Crop Protection was held on 20-21 August 2014. Crop protection was divided into two parts, i) Entomology and ii) Plant Pathology. A total of 120 participants (60 on 1st day and 60 on 2nd day) from BARI, BRRI, BJRI, BINA, BSRI, BTI, BSRTI, CDB and BARC were participated in the workshop. In this workshop Research progress for 2013-14 and proposed programs for 2014-15 was thoroughly discussed and decisions were made for implementation. Six expert members of respective field were also present in the workshop and gave their opinion/direction of research based on the national demand. Proceedings prepared based on the comments and opinion made on the workshop was sent to the respective institutes for necessary actions.

Review workshop on Crop Production Programme of NARS Institutes: Research Progress 2013-14 & Research Programme 2014-15

Annual Review Workshop on Crop Production Programme of NARS institutes was arranged during 24-25 August 2014. Seventy scientists from BARI, BRRI, BJRI, BSRI and BINA were participated. Research progress for 2013-14 and proposed research programs for 2014-15 were thoroughly discussed and

decisions were made for implementation. Expert members of respective fields were also present in the workshop and gave their valuable opinion/direction of research based on the national demand.

Project Completion Workshop on “Collection, characterization and utilization of rice, minor cereals and chili in Bangladesh” (Jan. 2012 to Dec. 2014) under AFACI-IMPGR project

The workshop was organized on 22 December 2014 to finalize the catalogue of the Plant Genetic Resources collected under the project. A total of 60 participants and 4 expert members were attended in the workshop including PI and Co-PIs of all AFACI projects in Bangladesh. The project has been completed successfully and one PCR and one catalogue have been published. The copy of PCR and Catalogue has been submitted to AFACI Secretariat in Korea.

Inception Workshop on “Collection, characterization and promotion of rice, chili, cucumber and melon in Bangladesh” (Jan. 2015 to Dec. 2017, 2nd phase of AFACI-IMPGR project).

A BARC coordinated project implementing by BARI and BRRI. The inception workshop was organized on 25 March 2015 to finalize the work plan to be implemented by BARI and BRRI as component organization. A total of 42 participants were attended in the workshop including four Expert members. Based on the comments work plan and budget have been revised.



Inception workshop of AFACI-IMPGR project

Expert consultation workshop for the development of innovative research in crop sector

The workshop was organized on 06-07 June 2015 to know the current status of innovative research conducted by different NARS institutes. The objective was to make plan of innovative research to meet up the

future challenges due to climate change effect and more food production through the development of climate resilient varieties and technologies. In the inaugural session Mr. Shyamal Kanti Ghosh, Secretary, MoA was present as the chief guest and Dr. Kazi M. Badruddoza, Scientist Emeritus chaired the session. Fifty five participants were attended in the workshop and 14 renowned scientists of crop sector of Bangladesh were present as expert members. The representatives of BARI, BRRI, BJRI, BSRI, BINA, CDB and SRDI presented on going innovative research of respective organization. A policy paper will be prepared based on the expert opinion and comments.

TTMU

National Workshop on Transferable Technologies of the NARS Institutes for Sustainable Food and Nutrition Security

A 2-day long National Workshop on ‘Transferable Technologies of the NARS Institutes for Sustainable Food and Nutrition Security’ was organized by Technology Transfer & Monitoring Unit (TTMU) at Bangladesh Agricultural Research Council (BARC) during 24-25 December 2014. The objective of the workshop was to transfer technologies developed by NARS institutes for sustainable food and nutrition security. Around 350 transferable technologies of crops, livestock and fisheries from 11 Research Institutes under National Agricultural Research System (NARS) were presented in the workshop. A total of 250 participants (scientists, extension personnel, academia, farmers, policy planners, GO-NGO personnel) were attended the workshop. The Honorable Minister, Ministry of Agriculture, Matia Chowdhury, MP was present as the Chief Guest and Secretary, Ministry of Agriculture, Dr. S M Nazmul Islam chaired the inaugural session as well as technical session on “Potato Storage through Indigenous Methods”. Dr. Md. Rafiqul Islam Mondal, Executive Chairman, BARC delivered the welcome address. Dr. Abul Kalam Azad, Member Director (Crops), BARC provided the vote of thanks.

Crop, livestock, fisheries and forest technologies of different institutes (BARI, BRRI, BJRI, BLRI, BINA, BSRT, BFRI, BFRI (forest) and BTRI) were presented in six different technical sessions. A total of seven

sessions including inaugural and concluding session comprised the workshop. The five technical sessions were chaired by the Director Generals (DG) of different NARS institutes and 12 expert-members were also participated in the technical sessions (2-4 members in each session based on the subject expertise). Dr. Abul Kalam Azad, Member Director (Crops), chaired the concluding session. A workshop-recommendation was presented by Dr. Mian Sayeed Hassan, Director (TTMU), BARC in the workshop which made mainly based on the lively discussions and comments of expert-members. The workshop was coordinated by Dr. Mian Sayeed Hassan, Director (TTMU) and Dr. Fauzia Yasmin, Principal Scientific officer (TTMU), BARC assisted him.

Planning and Evaluation

Annual work plan workshop 2014-15

A day long workshop on *Annual work plan workshop 2014-15* organized by Planning and Evaluation Division was held on 30 August 2014 at BARC conference room-1. The objective of the workshop was to review the progress of approved work plan of FY 2013-14 and discussion on annual work plan of FY 2014-15.

There was an inaugural session followed by technical sessions. The inaugural session was presided over by Dr. Paresh Chandra Golder, Member-Director (P&E), BARC. Dr. Md. Kamal Uddin, Executive Chairman, BARC was present as a chief guest. In the technical sessions, each Head of the Division/Centre/Unit has presented their activities and report in the workshop. Executive Chairman, BARC in his concluding remarks opined and hoped that all Division/Centre/Unit should revise their work plan according to the seminar comments. He also suggested that taking necessary action by all Head of Division/Centre/Unit in this regard.

Training Workshop on Project Preparation, Processing and Implementation

Two days training workshop on *Project preparation, Processing and Implementation* organized by Planning and Evaluation Division, BARC on 02-03 November 2014 at conference room-1, BARC. The objective of the Training Workshop was to develop skill on project preparation and management for Government officials,

Scientists of NARS and NGO's Officers. A total of forty participants participated in the training workshop.

Training on Project Development and Management

A five day-long training workshop on *Project Development and Management* was organized by the Planning and Evaluation Division, BARC during 07-11 December 2014. Dr. Md. Rafiqul Islam Mondal, Executive Chairman, BARC presided as a chief guest in the inaugural session. Dr. Paresh Chandra Golder, Member-Director (Planning & Evaluation) presided over the inaugural ceremony. Senior Officers from different divisions of BARC were also present in the inauguration ceremony. Dr. Md. Abdul Awal, Principal Scientific Officer (Planning & Evaluation) BARC and the course coordinator of the workshop delivered welcome address. Thirty participants from the different NARS institutes including BARC attended the workshop. Resource persons were drawn from BARC, National Academy for Planning and Development (NAPD), and Bangladesh Agricultural University. The course content of the training workshop included the topics on project cycle, project appraisal, logical framework, preparation of different types of project documents (DPP/RDPP/TPP), critical path method, result based monitoring, PPR-2008, financial delegations, SWOT analysis, Objectives tree analysis and problem tree analysis etc. The workshop was conducted based on class lectures, practical sessions and open discussions. The chief guest in his speech mentioned that this training workshop was organized to make the participants conversant with project planning and management. The chairperson of the training workshop in his speech hoped that this training would be helpful for the participants to prepare and manage different kinds of projects properly and efficiently. The workshop ended on 11 December, 2014 through a certificate giving ceremony where the Executive Chairman, BARC was present as chief guest.

Progress Review of Research Projects under Research Grant Fund of BARC

A two day-long workshop on *Progress Review of Research Projects under Research Grant Fund of BARC* was organized by the Planning and Evaluation Division, BARC during 23-24 June 2015. Dr. Abul Kalam Azad, Executive Chairman, BARC was present in the inaugural session as chief guest. Dr. Paresh Chandra Golder, Member-Director (Planning & Evaluation) presided over the inaugural ceremony. A

total of hundred participants participated in the workshop. The participant presented their research funding.

Livestock

Training Course on Peste des Petits Ruminants

A training with the title *Training Course on Peste des Petits Ruminants (PPR)*, was held in two batches: the 1st and 2nd batches were held in 24-25 May 2015 at Sylhet Agriculture University, Sylhet. A total of 55 Veterinarians and Livestock Officers (Veterinary Surgeons, ULOs, DLOs, DD and other officers) under Department of Livestock Services (DLS) of Sylhet Division attended the training course. Each batch of the training course included 4 classes that were taken by the experts from BARC and BAU. Each batch was initiated by an inaugural session where the Chief Guest was Prof. Dr. Md. Shahi Alam, VC, SAU; the Special Guests were Dean, Faculty of Veterinary and Animal Sciences, SAU and DD, DLS, Sylhet Division. Dr. Shah Md. Ziqrul Haq Chowdhury, MD (Livestock), BARC chaired the inaugural session. The batches of the training course were funded under Revenue Budget of BARC.

The Review of Livestock Research and Future Research Plan Preparation

Workshop on *The Review of Livestock Research and Future Research Plan Preparation*, was held on 8-9 June, 2015, that was initiated by an inaugural session where the Chief Guest was Dr. Abul Kalam Azad, Executive Chairman, BARC; the Special Guest was Dr. Md. Nazrul Islam, DG, BLRI. Dr. Shah Md. Ziqrul

Haq Chowdhury, MD (Livestock), BARC chaired the inaugural session. There were three Technical Sessions in the workshop in 2 days. A total of 12 papers from BLRI, BAU, CVASU, NIB and SAU (Sylhet) were presented under Technical Sessions-1 and -2 in 2 days. Review of Ruminant and Poultry Research Programs of Last 4 Years (July 2010- June 2014), Current Year (July 2014-June 2015) and the Future Research Plan for next 2 Years (July 2015- June 2017) were presented. Under Technical Session-3 (2nd day), there were group discussions under each of three groups (Group-1 for Large Ruminants (Cattle and Buffalo), Group-2 for Small Ruminants, and Group-3 for Poultry). Through discussion, Group-wise Future Research Plan for next 2 Years (July 2015- June 2017) was prepared and presented. The Future Research Plan for the next 2 Years in each group was corrected based on cross-group open discussions. A total of 43 participants from BARC, BLRI, DLS, BAU, CVASU, SAU (Dhaka), SAU (Sylhet), BSMRAU, NIB, Milk Vita, SAC and KGF attended the workshop in 2 days. A Proceeding of the workshop was also published. The workshop was funded under Revenue Budget of BARC.

Fisheries

The Division usually plans and implements several training courses every year on important subjects aiming to develop the skills of various stakeholders involved in fisheries production and processing and dissemination of developed technology. The courses were implemented with the coordination of DoF, Department of Youth Development and Sylhet Agricultural University.

Sl. no.	Training programs	Location	Dates
01	Tilapia Hapa breeding	Ashashuni, Satkhira	01- 02 December 2014
02	Cage Aquaculture	Ashashuni, Satkhira	03- 04 December 2014
03	Seabass Polyculture	Cox's Bazar	13- 14 December 2014
04	Shrimp Farming	Cox's Bazar	15 December 2014
05	Crab Fattening	Kalapara, Patuakhali	27 December 2014
06	Rice- fish culture	Sylhet Sadar, Sylhet	09-10 May 2015
07	Tilapia Hapa breeding	Sylhet Sadar, Sylhet	11-12 May 2015
08	Rice- fish culture	Sunmgonj Sadar, Sunmgonj	13-14 May 2015
09	Tilapia Hapa breeding	Sunmgonj Sadar, Sunmgonj	17-18 May 2015

Conducted workshops

- Freshwater Fisheries Research, Mymensingh
- Riverine Fisheries Research, Chandpur

- Marine Fisheries & technology station, Cox's Bazar
- Annual Research Review Workshop (BFRI/ BARC) on SPGR Progress Review Workshop
- Bi-annual conference of BFRF

Forestry, NRM

Training program on Forestry and Agroforestry Technologies for Professionals

A three day's training program was organized during 21-23 April, 2015 at BARC. The objectives of the training program were to train the NARS scientist for professional development. Sixty participants of NARS institute, different universities, Department of Agricultural Extension, Department of Forest and other organizations were participated.

National Seminar on Fruit Tree Plantation Program

Organized a national seminar on Fruit Tree Plantation Programme on 15 June, 2015 at KIB Auditorium, Farmgate, Dhaka. Honorable Speaker of National Parliament Dr. Shireen Sharmin Choudhury, MP, was present as Chief Guest and the Seminar was presided by Mr. Shamol Kanti Ghosh, Secretary, Ministry of Agriculture. Dr. Shabuddin Ahmed, Director, HRC, BARI was the keynote speaker.

World Food Day Seminar

World Food Day Seminar was held on 16 October 2014 at BARC auditorium. The seminar was organized by Forestry unit, NRM, BARC. The Seminar was presided by Secretary, Ministry of Agriculture Dr. S.M. Nazmul Islam, Honorable Agriculture Minister Motia Chowdhury, MP was the Chief Guest. The theme of seminar was "Family Farming: Feeding the world, Caring for the earth". Mr. Anwar Faruque, DG, Seed wing and Additional Secretary, Ministry of Agriculture presented the keynote paper.



Agricultural Engineering, NRM

Use of Farm Machinery and Efficient Irrigation System Management

Agricultural Engineering Section, BARC and Farm Machinery and Postharvest Process Engineering Division, BARI had jointly organized training course on *Use of Farm*

Machinery and Efficient Irrigation System Management (26-30 April and 10-14 May), 2014 at BARI, Gazipur. In each batch, twenty five NARS scientists BRRI, BARI and BINA participated to upgrade skill of agricultural machinery use and efficient irrigation system management in the field level. The objective of this training was to awareness development about the technologies available in NARS institutes to Agricultural Engineers, working DAE and NARS institutes.



Workshop

Agricultural Engineering Unit, BARC organized three national/annual workshops regarding prospective issues/need based in the field of Agricultural Engineering as follows.

Workshop on Use of Agricultural Implement, Research, Present Status of Extension and Future

The workshop was held on 14th September, 2014 at BARC, Dhaka Bangladesh. Begum Matia Chowdhury, Honorable Minister, Ministry of Agriculture, Government of the Peoples Republic of Bangladesh was present as Chief Guest and



Begum Matia Chowdhury, Honorable Minister, Ministry of Agriculture was present as Chief Guest in the inaugural ceremony

Dr. S.M. Nazmul Islam, Former Secretary, Ministry of Agriculture, Government of the Peoples Republic of Bangladesh was present as special guest. About 90 (ninety) Agricultural Engineer's and experts from MOA, Universities, DAE, BADC, NGOs and NARS Institutes attended the workshop.

Completion Report of Coordinated SPGR sub-project

Workshop on *Completion Report of Coordinated SPGR sub-project* which was held on 25th November, 2014 at BARC, Dhaka Bangladesh. Dr. Abul Kalam Azad, Former Member Director (A&F) was present as Chief Guest. About 70 (seventy) Agricultural Engineer's and experts from Universities, DAE, BADC, NGOs and NARS Institutes attended the workshop.

NARS Research Planning Workshop on Agricultural Engineering

A two days NARS Research Planning Workshop on Agricultural Engineering was held on 01-02 June, 2015 at BARC, Dhaka Bangladesh. Workshop evaluated of Agricultural Engineering Research Reports (2014-15) and Planning Future Research Program (2015-16) of NARS Institutes. The objectives of the workshop were to review the status and needs of agricultural engineering research in Farm Machinery, Irrigation & Water Management and Postharvest Technology. Ninety Agricultural Engineers from NARS Institutes, universities and other organization participated in the workshops. Participants offered valuable suggestions and recommendations in various issues on i) Farm Machinery, ii) Irrigation and Water Management iii) Postharvest Technology.

Soils, NRM

Use of Fertilizer Recommendation Guide 2012

Soils Unit of Natural Resources Management Division, BARC organized different training program for the NARS scientists, DAE Officers and junior teachers of universities in 2014. Three batches of training program on *Use of Fertilizer Recommendation Guide 2012* were conducted during 30 March-01 April 2014, 27-29 April 2014 and 25-27 May 2014. A total of 40 NARS Scientists, extension officers, and lecturer/assistant professors participated in each batch. Another training program on "Agricultural Land Management for Improving Soil fertility and Water use Efficiency" was organized under AFACI project on November 01, 2014. The scientists of the Unit took part in sharing knowledge with the

participants of these programs and provided with comments, suggestions etc. especially in the workshops and seminars. The scientists took part in a number of discussion meetings with the foreign delegates visiting BARC as well. Besides conducting training programmes, the scientists of Soils Unit also imparted the following training and study tour programs home and abroad during 2014-15.

AERS

Review of Socio-economic Research Programmes of NARS Institutes

A workshop on *Review of Socio-economic Research Programme (2014-15) and Future Research Programme (2015-16) of NARS Institutes* was held on 16 June 2015 at Bangladesh Agricultural Research Council (BARC), Farmgate, Dhaka. In the inaugural session Dr. Abul Kalam Azad, Executive Chairman, BARC was presented as the Chief Guest and Dr. S. M. Anwarul Huq, Member-Director (AERS), BARC presided over the session. A total of eighty five participants including scientists, professors, agriculture experts and delegates attended the workshop from different research organizations, universities and private sectors. The present and future research activities presented by the Head or nominee of the related division of NARS institutes. Two technical sessions were presided over by Dr. M. Shahadat Hussain, Ex Director General, BARI and Dr. S M Khalilur Rahman, Ex Member-Director (AERS), BARC, Dhaka. Five expert reviewers were reviewed the whole presented research projects critically. However, following suggestions/ recommendations were made by the house from the whole day workshop:

Bangladesh Agricultural Research Institute

Research Programme (2014-15):

BARI- 1. Import and Export Parity Analysis of Selected Vegetables and Spices in Bangladesh

- Its' needed to show price spreads and export parity of vegetables as well as to calculate the nominal protection coefficient for spices

BARI- 4. Assessment of BARI Mango Varieties in Comparison with Other Varieties

- For the adoption of mango variety its better to consider 16-20 years and then calculate cost and profit of it.

BARI-7. Profitability and Technical Efficiency of Turmeric Farming: Evidence from Khagrachari

- It would be better to show average production of turmeric instead of range.

BARI- 8. Financial Impact of Shifting of Land under Cereal Crops to Mango Cultivation in Selected

- Socio-economic development/ livelihood impacts of the farmers should be included due to shifting of land under cereal crop to mango cultivation. If the farms of mango will increase what will happen the other farms? What are the impacts of it? Including these the impact of food security and its impact on environment should be taken. Whether we export mango or not and is it positive for the country? To address these questions is needed to suggest policy guideline.

BARI-9. Sunflower Cultivation in Bangladesh: A Profitable Option for Fallow Land Utilization

- It could be expanded the adoption of sunflower cultivation in saline area. Some contradictory statements should be avoided. Need to recognize sunflower as a high value crop.

BARI- 12. Constraints and Opportunities of Cut-flower Production and Export from Bangladesh

- It is needed to estimate net protection co-efficient and use policy analysis matrix.

BARI-13. Production and Export Opportunities of Jara and Colombo Lemon from Bangladesh

- Its' very rare to attack by insect, pest and disease on zara and kolombo lemon. It is required to present the opportunities of it. Needed to estimate net protection co-efficient and use policy analysis matrix also.

BARI-14. Climate Variability Stresses, Adaptation and Capacity Assessment of Farmers in Some Selected Coastal Areas of Bangladesh

- Information should be taken on it in a particular area like saline area/environmental stress prone area and a specific season.

BARI- 16. Maize Supply and Demand Situations in Bangladesh: Policy Implications

- Its' needed to take study on trade/export of maize. Better to compare the BARI variety of maize with other variety. It is needed to use policy analysis matrix instead of only DRC.

Overall comments and suggestions:

- It is important to discuss the results according to the farm size. Most of the studies show the same recommendations.
- Is the application of insecticides or pesticide overdose or under dose should be identified.
- Sampling is important for data collection. Needs to use formula for selecting of sample. BARC might provide training on sampling technique.
- As a result of technical inefficiency how much does the amount of money loss will have to show.

Comments on Future Research Programme (2015-16):

- In programme 8, it is necessary to give concentration on sampling technique.

- In programme 10, it is necessary to take both types of labour- migrated family and non-migrated family for comparing both families. If the labour are migrated then to find out the impact of labour migration on production. Moreover, Char area should be included in this programme.
- Price distortion depends on several factors so that it should be included in program 7.
- Not only chickpea but also take other pulses in programme 1. Moreover, Sylhet can be included as sampling area in this programme.
- It is necessary to enumerate the short duration varieties for programme 2.
- Resource Optimization model can be used in programme 3.
- It is necessary to see the management practices and adaptation of the practices and its impact on productivity change and mention the recommended dose of different inputs for agricultural production practices. What is the difference between value chain and supply chain analysis should be addressed. Actors and factors of value chain analysis should be taken under study.
- Is it justified to take mango and tomato in programme 5. It is necessary to take a research program on mobile marketing of vegetables.
- There should be taken an initiative of making adoption index for wheat and other crops. Programs 16 and 3 should be merged.
- Program 12 can be a collaborated programme with BSRI.
- To identify cropping pattern changes it needs baseline data, which should be explained in programme 3.
- Value addition is a big factor in value chain analysis, which should be taken under consideration in programme 4.
- Title should be edited in programme 19.

Bangladesh Rice Research Institute

Research Programme (2014-15):

- There is no any program on hybrid rice.
- The program on 'food habit and livelihood of garment workers in Bangladesh' has been taken on what basis?
- The study on 'crop land shift into mango orchard' is the duplication of BARI program on financial impact of shifting of land under cereal crop to mango cultivation.
- Agricultural Economics Division should be strengthened.
- Adoption rate of modern rice varieties is very poor. Hence, research should be taken on new HYVs as well as hybrid rice and their technologies.

- Irrigation related research programmes should be undertaken.
- Value chain has not been completely explained. It can be said supply chain.
- Impact study should be included in the research programmes.

Comments on Future Research Programme (2015-16):

- It is necessary to make pre evaluation and post evaluation in programme 7.
- In programme 7, budget and sample are not matched. It is necessary to make comprehensive report.
- No need to say ‘selected areas of Bangladesh’ as it’s taken only for one district.

Bangladesh Sugarcane Research Institute

Research Programme (2014-15):

- In subsidy, the analysis was done in terms of financial analysis, which should be done in terms of economic analysis.
- In marketing related research programmes, DRC and import parity of sugarcane should be estimated.
- An integrated project should be undertaken to reach the technologies to the farmers.
- How much does the percentage of benefit should be estimated after giving subsidy.

Comments on Future Research Programme (2015-16):

- Research programme should be undertaken on sugar beet.
- It should be made a comparative analysis with intercropping.

Bangladesh Institute of Nuclear Agriculture

Research Programme (2014-15):

- Bina-til should be compared with other sesame.
- BINA can invite the experts from BAU for developing the program.
- A comparison is needed between hybrid and GM crops with the analysis.
- Yield gap between research station and farmers’ field could be calculated.

Comments on Future Research Programme (2015-16):

- Programmes on comparative analysis between BARI and BINA crops should be undertaken.
- It is necessary to observe adoption and profitability of BINA mustard and mung bean compared to BARI varieties

Computer and GIS Unit

1. Training on *Windows MS Office & Unicode* was organized at Computer & GIS Unit, BARC during 30

- May-04 Jun and 14-18 Jun 2015 (10 days) . Forty staffs of BARC participated in the programme
2. Training on *QGIS* was organized at Computer & GIS Unit, BARC during 12-17 Oct 2014 (5 days) with the financial of CIMMYT. Twenty officers of NARS, Universities and BARC participated in the programme
 3. Training on *MIS modules* was organized at Computer & GIS Unit, BARC during 22-26 Mar 2015 (5 days). One hundred participants form NARS and BARC attended the course.
 4. Training on *Crop Suitability Assessment Model (CSAM)* under SPGR Sub-project was organized at Computer & GIS Unit, BARC during 15-16 Sep 2014 (2 days). Twenty officers of NARS and BARC participated in the programme.
 5. Training workshops on *Use of ARMIS and its operation* were conducted at 4 locations under ARMIS project, i) BARI Auditorium on 23 Dec 2014. participated 55 officers from BARI, BRRI, BSMRAU, NATA, SCA; ii) BJRI Committee Room on 26 Jan 2015 where 85 officers from BJRI, BLRI, SAU, SRDI, CDB, JU, DU, DoF, DAE, BAS, BARC, IRRI, CIMMYT, BADC, DLS participated; iii) BINA Conference Room on 12 Apr 2015. Sixty officers from BINA, BFRI, BAU and BARC participated and iv) BFRI Auditorium on 12 May 2015 where 65 officers from BFRI (Forest), BARI, CU, SRDI, CVASU, BARC
 6. Workshop on *Awareness building on ARMIS* was organized at BARC Auditorium on 10 Dec 2014. Twenty officers from BARC, NARS, Universities, NGOs and others ARMIS project participated.
 7. Workshop on *Service Innovation through ICT* was organized at BARC Conference Room on 30 Jun 2015 where 50 officers of NARS and BARC participated.

Manpower Development Activities

During the reporting period (June 2014 to July 2015) a total of 3843 scientists/officers from the NARS institutes/other associate organizations participated in the Revenue/NATP/ other sources funded training/workshop/seminar/higher study programs at home and abroad. It may be mentioned that 948 scientists/officers attended the revenue funded training programs and 1008 scientists/officers took part in the revenue funded workshop.

Alongside its regular activities involving the management of higher study programs (in-country revenue funding PhD program and CSISA-BD Ph.D program), the

Manpower and Training Unit during the year organized 12 programs including two training programs (Administrative and Financial Management Training for CSO/PSO level Scientists, Training of Research Methodology) two workshops (Sharing of experiences of the Post-doctoral Fellows under NATP: Phase-1 and Opinion exchange meeting with the YAAS delegation), six seminars and two meetings. The major activities that Manpower and Training Unit has accomplished/ helped implementation during the reporting period are delineated below.

Training Program on Administrative and Financial Management

BARC organized a 14-day training program on Administrative and Financial Management during 21 September to 02 October 2014 at Bangladesh Academy for Rural Development, Cotbari, Comilla. This was the 21st training batch comprising 35 senior level (CSO/PSO) agricultural scientists from NARS institutes. The objective of the training program was to provide these senior level scientists/ researchers with the modern concepts of administrative and financial management system. The inaugural session of the training course was held on 21 September 2014 at 10:30 a.m. in the IT conference Hall of BARD. Mr. Mohammed Mir Kashem, Additional Director General, BARD presided over the session. Among the others, Mr. Md. Aminuzzaman, Director (Manpower & Training), BARC, Dr. Kamrul Ahsan, Director (Training), BARD, Course Director, Dr. Masudul Hoq Chowdhury, Director (Rural Education and Social Development), BARD spoke on this occasion.

Training on Research Methodology

Under the funding from PIU-BARC: NATP, Phase-1 BARC organized two training programs on Research Methodology at Graduate Training Institute (GTI) of Bangladesh Agricultural University, Mymensingh. The duration of each of the training program was 13 days and each of the training program was attended by 30 entry level NARS scientists. The two training programs were held during 18-30 October 2014 and 01-13 November 2014.

The objective of this training program is (1) to equip the participants with necessary knowledge and skill in planning, execution, monitoring and evaluation of research activities (2) develop analytical skill of participants in data compilation, data interpretation and report preparation (3) enable the trainees in writing and reviewing scientific articles of int'l standard and (4) upgrade the skill of the researchers in writing research proposal and manage the project effectively.

In Country PhD (Revenue)

One of the major tasks of Manpower of Training Unit of BARC is to offer higher studies for NARS scientists in various disciplines of agriculture. Eighteen (18) NARS scientists who started PhD research in the fiscal 2008-2009, have completed their research. Meanwhile, since the financial year 2013-2014 a new batch of 19 NARS scientists have begun PhD research under revenue funding. The financial management and performance monitoring activities in this connection are being carried out as usual.

In Country PhD (CSISA-BARC Scholarship Progam):

There was a provision of five slots for in-country PhD under CSISA-BARC Scholarship Program. All the five PhD researchers - one from BARC and two from BARI, one from BINA and another from BFRI (fisheries) are involved with their PhD research activities. The program is being jointly funded by IRRI, CIMMYT and WorldFish Centre under CSISA-BD project. The financial management and performance monitoring activities in this connection are being carried out as usual.

In Country PhD (PIU-BARC): NATP Phase -I

Under PIU-BARC, NATP: Phase-1 there were provisions of 60 national PhD scholarships in various fields of agriculture in the country. During the reporting period all 60 PhD researchers have completed their study. Again 19 scientists/ officers have completed PhD under the SPGR projects by this financial year. The financial management and performance monitoring activities were carried out by PIU-BARC: NATP.

Foreign PhD (PIU-BARC) :NATP, Phase-I

Again, under the PIU-BARC: National Agricultural Technology Project (NATP) Phase-1, a number of 30 slots were earmarked for foreign PhD programs for the scientists of National Agricultural Research System (NARS) in the countries like Malaysia, Thailand, China, Philippines, India and Sri Lanka. On receipt of progress reports scholars' allowances and research grants disbursed. 28 scholars have completed their PhD programs and the remaining one is expected to complete his degree by 2015. (One, BJRI scientist, has expired). It is hoped that the scholars through their knowledge in agriculture gained abroad would enrich and accelerate the scientific advancement in Bangladesh agriculture.

Foreign Training/seminar/workshop/study tour

During the reporting period other than in country activities, Manpower and Training Unit also initiated and

implemented foreign training/seminar/workshop/ meeting in different countries of the world. A total number of 41 research managers/scientists/personnel under different fields of agriculture and cross cutting issues attended to help enrich their professionalism in order to achieve the country's ultimate goal to ensure food security. Detailed activities are furnished below:

Participation in Foreign Training/Workshop/Seminar/Meeting

Sl. N	Name.Desg. & Org.	Name of Program	Duration	Country	Funding Org.
01	Dr. Abul Kalam Azad, M-D (Crops) CC	The Forty-eighth Session of the Programming Committee Meeting of SAARC	26-28 October 2014	Nepal	SAARC
02.	Dr. Shaikh Mohammad Bokhtiar, Director (SS), BARC	Workshop on: South Asia Agricultural Science and Technology Training Class and Workshop of the Exchange and Cooperation Consortium for Agricultural Science and Technology	11-25 August 2014	China	YAAS, China
03	Md. Aminuzzaman Director (Training) BARC	Do	Do	Do	Do
04	Dr. S.M. Khorshed Alam, PSO, BARC	Do	Do	Do	Do
05.	Dr. Mian Sayeed Hassan, Director (TTMU), BARC	AFACI Expert Workshop on Program and Agricultural Produce Safety Information System (GAP)	19-23 August 2014	Bali, Indonesia	AFACI-GAP
06	Dr. Sultan Ahmed, M-D (NRM), BARC	The 2 nd Regional Forum on Sustainable Agricultural Mechanization in Asia and the Pacific.	9-11 September 2014	Serpong, Indonesia	CSAM
07.	Dr. Sultan Ahmed, M-D (NRM), BARC	The 1 st Annual Meeting of the Asia and the Pacific Network for Testing of Agricultural Machinery (ANTAM)	16-19 September 2014	Beijing, China	CSAM, UNESCAP
08	Dr. Md. Abdus Salam, PSO (Crops) BARC	Training on Analytical Techniques used in Nutrition, Food Safety and Biosafety at ICRISAT Campus, Patancheru, Telanga, India.	01-14 September 2014	India	ICRISAT
09	Md. Mosharf Hossain, Joint Secretary, MOA	Training/Workshop Program of "Food Safety Management"	15-24 October 2014	Germany	NATP Phase-I
10.	Dr. Md. Kabir Iqramul Haque, M-D (Fisheries) BARC	Training/Workshop Program of "Food Safety Management"	15-24 October 2014	Germany	NATP Phase-I
11.	Dr. Md. Monirul Islam Director (Nutrition) BARC	Training/Workshop Program of "Food Safety Management"	15-24 October 2014	Germany	NATP Phase-I
12.	Dr. Abul Kalam Azad, M-D (Crops) CC	The Forty-eighth Session of the Programming Committee Meeting of SAARC	26-28 October 2014	Nepal	SAARC
13.	Farida Jahan, Joint Secretary, Ministry of	Study Visit "Development of Variety, Cropping System	27 October	Korea	AFACI

	Agriculture	research and technology transfer of major cereals for sustainable food security in Bangladesh".	to 02 Nov. 2014		
14.	Dr. Benoy Chandra Sen, Deputy Director, Department of Agricultural Extension	Do	Do	Do	Do
15.	Mr. M Kamrozzamna, PSO, BARI,	Do	Do	Do	Do
16.	Md. Mustafizur Rahman, PTO, BARC	Do	Do	Do	Do
17.	Mosammat Mustari Khanaum, Senior Assistant Secretary, MOA	Do	Do	Do	Do
18.	Dr. Sultan Ahmed, M-D (NRM), BARC	The 10th Session of the Technical Committee of CSAM & the Regional Workshop on Establishing a Regional Database of Agricultural Mechanization in Asia and the Pacific	17-19 November 2014	Combodia	CSAM, UNESCAP
19.	Dr. Md. Baktear Hossain, PSO(Soil), BARC	Climate Change, Agriculture and Food security Workshop: Opportunities for Regional Collaboration	19-21 November 2014	Ho Chi Minh City, Vietnam	CCAFS-SA
20.	Mr. Kuasha Mahmud, PSO, BSRI	The International Conference: IS-2014 in Nanning	25-28 November 2014	China	NATP, BARC
21.	Shaikh Mohammad Bokhtiar, CSO, NRM, BARC	The 5th International Conference: IS 2014, "Green Technology for Sustainable Growth of Sugar & Integrated Industries in Developing Countries.	25-28 November 2014	China	IS 2014
22.	Dr. Md. Shahjahan CSO, BARC	Training on Research Methods in Agroforestry	01-05 December 2014	India	ICRAF
23.	Mr. Ajit Kumar Chakraborty, Deputy Director (Account) BARC	Training Financial/Office Management	18-25 December 2014	Malaysia	PIU-BARC NATP
24.	Mr. Md. Daloar Hossain, Senior Assistant Director (Est.), BARC	Do	Do	Do	Do
25.	Mr. Md. Mofazzal Hossain, Cotton Dev. Officer, Dhaka	Do	Do	Do	Do
26.	Dr. Mian Sayeed Hassan, Director (TTMU), BARC	The Launching and Planning Workshop of CCAFS Flagship Projects on Climate Smart Agriculture	24-25 February, 2015	India	CIMMYT, IFPRI
27.	Dr. Md. Monirul Islam, Director (Nutrition), BARC	The Workshop on the Regional Initiative to Support the Zero Hunger Challenge in South Asia and the Pacific	11-12 March 2015	Thailand	FAO
28.	Dr. Md. Aziz Zilani Chowdhury, MD (Crops), BARC	The 4 th BIMSTEC Expert Group Meeting on Agriculture Cooperation.	06-07 April 2015	Kathmand, Nepal	BIMSTEC

29	Dr. Md. Abdus Salam, PSO (Crops), BARC	3 rd AFACI International Training Workshop on Germplasm Management System	11-20 May 2015	Jeonju, Korea	AFACI
30	Dr. Sajia Rahman, SSO (PGRC), BARI, Gazipur	Do	D0	Do	Do
31	Humayun Kobir, DAE, Khamarbari, Dhaka	1 st AFACI International Training Workshop on Post-harvest Management Technology for Horticultural Crops	7-20 June 2015	Bangkok Tahiland	AFACI
32.	Dr. Taslima Ayesha Akter Nasrin, SSO, BARI	Do	Do	Do	Do
33	Mr.Md. Nazrul Islam, Project Director, DAE, Dhaka	"Improving Productivity of Pulses in Asia"	29-30 June 2015	Bangkok Tahiland	FAO
34	Dr. AKM, Mahbubul Alam, PSO (Crops), BARC	Do	Do	Do	Do
35	Susmita Das, Senior Documentation Officer,AIC, BARC	Modernizing Extension and Advisory Service (MEAS) Symposium	3-5 June 2015	USA	CSISA-BD
36	Md. Abdur Rouf, Joint Secretary, PPB, MoA	In the study visit on Maharastra Agricultural Competitive Project	16-24 June 2015	India	PCMU
37.	Nargis Khanam, Deputy Chief, Crops Wing, Planning Commission	Do	Do	Do	Do
38.	Md. Abdur Razzaque, Project Director, PCMU	Do	Do	Do	Do
39	Md. Kabir Ikramul Haque, MD (Fisheries) BARC	Do	Do	Do	Do
40	Md. Abdullah-Al- Mustasim Billah, Assistant Chief, Ministry of Fisheires and Livestorck	Do	Do	Do	Do
41	Mohammad Fahim Afsan Chowdhury, Assistant Chief, Planning-2, MoA	Do	Do	Do	Do

In-country Training/Seminar/Workshop (Revenue)

During the reporting period 18 training programs and 14 workshops were arranged by different divisions/units/centre of BARC under revenue funding in

which 948 and 1008 scientists/officers took part. Five seminars were also organized by the Manpower and Training Unit under revenue funding in which 240 scientists/officers participated.

Training (Revenue)

Div/Unit	Activities	Venue	Duration	No. of Participant
Crop	Training on Knowledge and Awareness Building on Agricultural Policies of Bangladesh	BARC	May 5-7, 2015	40
	Training on agricultural technologies for adaptation to climate change in Bangladesh	BARC	10-11 June/15	42
	Training on Food Safety & Phyto-sanitary measures	BARC	7-8 June/15	40
	Training on Biosafety Measures in Crop Biotechnology	BARC	30-31 March 2015	38

NRM	Training on Use of Farm Machinery and Efficient Irrigation System Management	BARC	26-30 Apr/ 15 10-14 May/15	50
	Training on use of Fertilizer Recommendation Guide-2012	BARC	3 days 25-27 May, 2015	40
	Training on Forestry & Agroforestry Technologies for Professionals (BARC, BFRI, DoF, BFIDC, BARI, Universities, DAE, NGOs & Others)	BARC	21-23 April 2015	60
Nutrition	Training on quality processing and preservation of agro-products.	BAN HRDB District level	26-31 May 2015	30
Livestock	Training course on Peste des Petits Ruminants (PPR)	Sylhet	24-25 May '15	60
Fisheries	Training on Rice Fish Culture	Sylhet Sadar, Sunamganj Sadar,	2 days 9-10 May/15 13-14 May/15	60
	Training on Hapa breeding of Telapia (one batch)	Sylhet Sadar/ Sunamganj Sadar/	2 days (11-12 May/15) 17-18 May/15	60
Computer & GIS	Training on GIS/ MIS modules	BARC	22-26 April 2015	100
	Windows, Ms Office and Unicode	BARC	30/5/15- 2/6/15 7-11 June/15	36 (Staff)
TTMU	Training on Recent Developed Technologies of Field Crops	BARC	16-18 June/15	40
	Training On ToT for Production Technology of Mango for DAE Officers/Scientists	Chapainawa bganj	2/6/2015	80
	Training on Potato storage at normal temperature (DAE officers and SAAO)	Munshiganj	7-8 June/15 (2 batches 40 each)	80
AIC	Training Program on Photography, Video Production and Post Processing	BARC	7-11 June/15	13
MD(A&F)	Vehicle safety , Road Safety and Personnel Management Training &Training on How to improve Personnel Management Perfomance	BARC	7-11 June/15 14-18 June 21-25 June	79 (staff)
	Total 18 Training Programs			948

Workshop (Revenue)

Div/Unit	Activities	Venue	Duration	No of Participant
Crops	Review Workshop on Crop Improvement Programme: Research Progress 2013-14 & Research Programme 2014-15.	BARC	18-19 Aug 2014	70
	Review Workshop on plant protection Programme: Research Progress 2013-14 & Research Programme 2014-15.		20-21 Aug 2014	130

	Review Workshop on Crop Production Programme: Research Progress 2013-14 & Research Programme 2014-15.	BARC	24-25 Aug. 2014	70
	Expert Consultation Workshop for the Development of Innovative Research Programme in Crop Sector	BARC	6-7 June/15	70
P&E	Annual Workplan Review Workshop	BARC	28 Aug. 2014	50
	1.Workshop on Progress Review of Research Grant Projects	BARC	2 days 23-24 June/15	90
AERS	Review workshop of Socio-Economic Research Programs of NARS Institute	BARC	16/6/15	85
NRM	Agricultural Engineering Research Planning Workshop	BARC	(1-2 June/15	100
	Research Review and Program Planning Workshop on Soil Management Program of NARS Institutes	BARC	23-25 Aug 2014	70
	Review Workshop on Forestry & Agroforestry Research Activities of different NARS Institutes & Universities	BARC	26-28 May/15	60
Nutrition	Workshop on uses of pesticides/ripening chemicals in fruits: health effects and consumer awareness	Dhaka/Rajshahi	8 June 2015	110
Livestock	Workshop on the Review of Livestock Research and Future Research Plan Preparation (Scientist/officers/Univ Teachhers)	BARC	8-9 June/15	53
Computer	Workshop on Institutionalization of MIS	BARC	28/6/15	50
	Total Program :14			1008

Additional Program organized under AFACI/KGF funding

Training:

Division/ Unit	Activity	Venue	Duration	No. of Participants	
Crops	Training on Post-harvest technology on horticultural crops	BARC	9-10 Dec. 2014	50	AFACI

Workshop:

Div/ Unit	Activity	Venue	Duration	No. Participants	
CROPS	Inception Workshop of AFACI-IMPGR Project	BARC	23/2/2015	40	AFACI
	Progress Review Workshop on Collection, Characterization and Utilization of Rice, minor cereals and chilli in Bangladesh under AFACI Pan Asian Project	BARC	24 July, 2014	40	AFACI
	Workshop on Collection, characterization, utilization of rice, minor cereals and chilli in Bangladesh (IMS-PGR), AFACI	BARC	24 Dec. 2014	65	AFACI
	Workshop on the Transferable Technologies of the NARS Institutes for Sustainable Food and Nutrition Security	BARC	24-25 Dec. 2014	245	AFACI
Computer	Workshop on Awareness Building on ARMIS	BARC	1 day Dec./2014	40	KGF
	Total: Five workshops			430	

**PIU-BARC: NATP Phase 1 Funded Training/Workshop
Seminar (July-December 2014)**

Training (NATP)

From July-December 2014 following five (5) training

programs were organized in which 195 officers/scientists took part from the NARS institutes and extension departments

Sl.	Name of Training	Duration	No. of Participants	Venue
1.	Administrative and Financial Management for PSO/CSO of NARS	21 Sept. to 03 October 2014	40	BARD, Comilla
2.	Project Preparation, Processing and Implementation	02-03 November 2014	35	Conference Room-1, BARC
3.	Research Methodology (Two batches)	18-30 October/14 & 1-13 Nov/14	60	GTI, Mymensingh
4.	Project Development and Management	07-11 December 2014	30	Conference Room-1, BARC
5.	Awareness Building on the Importance of Nutrition Information	27-31 December 2014	30	Kutubdia, Cox'sbazar
	Total five training programs		195	

Workshop (NATP)

From July-December 2014 eight (8) workshop were

organized in which 525 officers/scientists took part from the NARS institutes and other concerned organizations:

Sl. No	Name of seminar/workshop	Date	No. of Participants	Venue
1.	Present Status Research and Extension of Mechanization and Future Planning	14 September 2014	90	Conference Room-1, BARC
2.	Rationalization studies: Institutional Reform of Research Management & Financial Management	17 September 2014	80	Conference Room-1, BARC
3.	Expert Consultation Workshop on the preliminary findings of the National Consultant on "Rationalization studies: Institutional Reform and Research Management"	25 September 2014	80	Conference Room-1, BARC
4	Comprehensive Policy Plan for National Agricultural Research System (NARS)	29 September 2014	35	Conference Room-1, BARC
5	Workshop on Exchange and Cooperation Consortium for Agricultural Science and Technology, China-South Asia (BD. Chapter)	13 October 2014	40	Conference Room-1, BARC
6	Sharing of Knowledge of Foreign Post Doctoral Fellows under PIU-BARC, NATPP-1	16 November 2014	70	Conference Room-1, BARC
7	Key Performance Indicators and Performance Contracting	03 December 2014	60	Conference Room-1, BARC

8	Expert Consultation Workshop on Rationalization studies: Institutional Reform of Research Management & Financial Management	18 December 2014	70	Conference Room-1, BARC
	Total		525	

Manpower and Training Unit, BARC organized or supported during 2014-2015 under revenue and other funding sources organizing the following seminar/meetings.

Seminar (Revenue)

Sl. No	Workshop/Seminar/Events	Date	Venue	No. of Participants	Funding Source
1.	Workshop on Exchange and Cooperation Consortium for Agricultural Science and Tech., China-South Asia (Bangladesh Comp.)	13 Oct. 2014	BARC Conference Room-1	40	Revenue
2	Meeting for Setting Criteria for age increase of scientists	5 Jan 2015	BARC Conference Room-1	30	Revenue
3	Seminar on Use of Biotechnology in Agricultural Development	29 Dec 2014	BARC Conf.Roo m	55	Revenue
4	Seminar on Identification and Characterization of Disease Suppressive Soils and Genetic Diversity of Rhizobia Nodulating Lentils	11 Jan. 2015	BARC Conf.Roo m	55	Revenue
5	Seminar Sustainable Water and Ecosystem Management in Coastal Areas under Climate Change in Bangladesh	26 Feb. 2015	BARC Conf.Roo m	60	Revenue
				240	

Seminar (Other funding sources):

Sl. No	Workshop/Seminar/Events	Date	Venue	No. of Participants	Remark
1	Seminar on The Current Status of Golden Rice Research and Regulatory Issues	23 June 2015	Training Hall, BARC	56	IRRI
2.	3 rd CGIAR Advisory Committee Meeting	16 April 2015	BARC Conference Room-1	60	CIMMYT
3	Seminar on Bugs in the System: Why Crop Protection Practices Affect Trade, Consumer Health and Biodiversity”	3 March 2015	BARC Conference Room-1	70	FAO
4	Seminar on Application of the Sustaina Livelihood Framework to the Designat Monitoring and Evaluation of GIAHS: Case Study in Bangladesh	14 June 2015	BARC Conference Room-1	70	FAO
				256	

Summary of HRD activities at BARC (2014-2015)

Sl. No	Activities	No. of Participants	Funding Sources		Remarks
01.	Local Training (Short-term) (22) (16+5+1)	948	Revenue		
		195	NATP		
		50	AFACI		
02	Local Training (Long-Term)	In country-PhD	60	NATP	Completed
		In country-PhD	19	NATP (SPGR)	Completed
		Foreign PhD	29	NATP	Completed
		In country PhD	18	Revenue	Completed
		In-country PhD	19	Revenue	On-going
		In-country PhD	5	CSISA	On-going
	Foreign (S.T)		25	NATP/other	
	Sub-total: Training (22)	1368			
03	Local Workshop (27) (14+8+5)	1008	Revenue		
		525	NATP		
		430	AFACI		
	Foreign Workshop	16			
	Sub-total (Workshop) (27)	1979			
04	Local Seminar/meeting (9) (5+4)	240	Revenue		
		256	FAO/IRRI		
	Sub-total (Seminar) (9)	496			
	Total (Training/Workshop/Seminar) (58)	3843			

Workshop, Training, Seminar, Meeting etc attend by the Scientists

TTMU

During July 2014 to June 2015 Officers of TTMU has attended a good number of Workshops, Seminars and Meetings in home and abroad. Some of the important events of Dr. Mian Sayeed Hasan, Director (TTMU) are listed below:

- i. Presented project report in the Principal Investigator (PI) workshop of AFACI GAP project organized by AFACI at Bali, Indonesia during 19-23 Aug 2014.
- ii. Presented Country report on Background, Introduction and Overview of the Project Development of Standards and Scheme for Good Agriculture Practice (GAP) Implementation and Certification in Bangladesh in the Regional Consultation workshop on “Implementation of Good Agricultural Practices in SAARC Countries: SAARC GAP Scheme” organized

by FAO Regional Office for the Asia and Pacific in Collaboration with SAARC Agriculture Centre, Bangladesh during 22-23 Sept, 2014, Dhaka, Bangladesh.

- iii. Presented Country report on “Good Agriculture Practices (GAP) Status in Bangladesh” organized by FAO RAP and BARC on 25 Sept, 2014 at BARC.
- iv. Attended and co-chaired the “Launching and Planning Workshop of CCAFS Flagship Project (FPs) on Climate Smart Agriculture: Practices Portfolios, Institutions and Policies” organized by International Maize and Wheat Improvement Center (CIMMYT) & International Food Policy Research Institute (IFPRI) during 22-25 Feb 2014 and Indonesia during 19-23 Aug 2014 and presented project report.
- v. Attended and presented country report on ‘Innovative National Agricultural Research and Development Programmes of Regional Significance of Food Crops, Livestock, Fishery & Natural Recourses’ in the Inter-

Governmental Core Group on Agricultural Research, Extension and Farmer's Linkages (IGCG-REF) organized by IGCG-REF, SAARC Secretariat, Kathmandu, Nepal during 24-27 June 2015.

During July 2014 to June 2015 TTMU attended a good number of Workshops, Seminars and Meetings in home are listed below:

Forestry, NRM

Attended a number of workshop, seminars, conferences and technical meetings held during the reporting periods. Contributions were made in the form of paper presentation, as rapporteur of technical sessions and report presentations, facilitator in the working group interactions. Also worked as External Examiner of the Dept. of Soil Science, PSTU, Patuakhili and Dept. of Agroforestry, SAU, Dhaka

Computer and GIS

- Training on Service Innovation at Department of Agriculture Extension (DAE). Conducted By A2i program, PMO
- Training on Digital signature at Bangladesh Computer Council (BCC). A2i program, PMO
- Training on BARC website development and anchoring with national web portal at Bangladesh Computer Council (BCC). A2i program, PMO office
- Training of Trainers (TOT) on National web portal at Prime Minister's Office (PMO). Conducted by A2i program, PMO office
- Training related to awareness building of disaster management at Bangladesh Meteorological Department (BMD).

Visit Abraod

Crops

One scientist attended in each of the AFACI Expert Workshop on Integrated Management System of Plant Genetic Resources (IMPGR) held in Nonthaburi, Thailand during 7-11 November, 2012; Kathmandu, Nepal during 23-27 September, 2013 and Kandy, Sri Lanka during 25-29 August, 2014.

Three scientists in 2013 and two scientists in 2014 attended the 1st and 2nd AFACI International Training Workshop on Germplasm Management System held in NAC, NAAS, RDA, Suwon, Korea.

Two scientists attended the 3rd AFACI International

Training Workshop on Germplasm Management System held in NAAS, RDA, Suwon, Korea in 2015.

Forestry, NRM

Dr. Mohammad Shahjahan, Chief Scientific Officer participated in the training on Research Methods in Agroforestry in India during 1-5 December 2014.

Agricultual Engineering, NRM

Dr. Sultan Ahmed, MD (NRM), attended following workshop/meeting:

1. The Second Regional Forum on Sustainable Agricultural Mechanization in Indonesia during 09-11 September 2014 under UNESCAP-FAO CSAM funding
2. 1st Annual Meeting of the Asian and Pacific Network for testing of Agricultural Machinery (ANTAM) in China during 16-19 September 2014 under UNESCAP-FAO CSAM funding.
3. The 10th Session of the Technical Committee (TC) of CSAM & the regional Workshop in Cambodia during 17-19 November 2014 under UNESCAP-FAO CSAM funding.

Soils, NRM

PSO (Soils) attended training program on Building Capacity on Climate Change Adaptation held at IWM, Dhaka during 19-29 March 2015

PSO (Soils) Presented Country report of the AFACI funded Soil Fertility Project in 20th World Congress of Soil Science and Expert workshop meeting held during 8-13 June 2014 in Jeju Island, Korea.

CSO (Soils) presented Country report of the AFACI funded project entitled "Production and Services of Agrometeorological Information for the Adaptation to Climate Change in Bangladesh" held during 03-07 June 2014 in Ulaanbaatar, Mongolia

PSO (Soils) attended an international workshop on Climate Change, Agriculture and Food Security Workshop: Opportunity for Regional Collaboration held in Ho Chi Minh City, Vietnam during 19-21 November 2014

CSO (Soils) attended an international workshop on "Determination of Site Specific Fertilizer Requirement of Sugarcane and Potato as Intercrop under Sugarcane Based Cropping System" held during 25-28 November 2014, Nanning, China.

AERS

Participation of a Regional Workshop in Indonesia on *Measuring Sustainable Agriculture, Food Security and*

Poverty Alleviation for Enhancing Accountability in the Post-2015 Development Agenda- organized by CAPSA.

Participation of a Training Course in China on *Communication and Advocacy for Agricultural and Rural Statistics* organized by SIAP.

Computer and GIS Unit

Visited Expert workshop on *ATIN (Agricultural Technology Information Network)* project of AFACI in Indonesia during 21-25 October, 2014

Visited Internal Partners Intensive Workshop (IPIW) ICRISAT, Telangana, India during 20-24 May, 2015 under IGB Project.

III. AGRICULTURAL INFORMATION AND PUBLIC RELATIONS

AGRICULTURAL INFORMATION

BARC devotes considerable efforts and resources for the development of an outstanding library collection to meet the expanding needs of agricultural research and to serve as an information resource centre for NARS institutes.

Development of Collection

Until June 2015 the library has a total collection of about 23,900 information materials, which includes books, reports, pamphlets and bound journals etc. The following information materials have been procured during the period under report:

<u>Items</u>	<u>Quantity</u>
Books and Reports	165
Current Journals/Newsletter	29

Literature Search

The Centre renders literature search services from full-text database - The Essential Electronic Agricultural Library (TEEAL) CD database to satisfy the researchers, agricultural scientists, planners and policy-makers. It also provides search services on specific requests received from teachers, students and users from NARS institutes and other organizations. The library provided search service from TEEAL to 60 external users.

Services and Users

During this period 347 users of different categories have used the library. Besides the BARC and NARS scientists, teachers and students of Universities, NGO and private organizational personnel are the users of this library.

Update and Maintenance of databases

- Database on Books and Reports contains 6,000 records out of which 165 records have been added during this year
- Database on Journals, Newsletters, and Periodicals contains 1110 records and being updated regularly.

News Clipping Services

Five hundred eighteen articles (Bangla and English) have been identified, processed in different format, compiled

and prepared a content list and preserved in the library for users.

Online Archive of Important Documents

Developed a database driven online archive based on Content Management Systems (CMS). The database contains digital contents of non-conventional documents of high archival value (Policy documents, Reports of all kinds, Proceedings and other mimeographs). The database contains full text information of about 920 records.

Resource Sharing

The library also performs resource sharing activities to serve the scientists. In this period, the library has collected information materials from FAO, BBS, BANSDOC and all NARS institutes.

AIC also has taken photographs of 91 workshops/training/seminars/meetings and supplied 2299 photos in digital form to the concerned divisions and provided 101367 photocopies of official documents, reports, letters, scientific literature etc. under 4,529 requests.

Activities Relating to BJA

During this period 20 articles have been received from the authors for publishing in the Bangladesh Journal of Agriculture (BJA). The articles have been processed following selecting reviewer/over viewer and making comparison of articles received from reviewers/overviewer after correction made by the authors.

PUBLICATIONS

Preparation/Presentation/Publication of Research Articles/Papers

Crops

Project Completion Report of SPGR Coordinated Sub-Project: “Characterization of Important Plant Genetic Resources: BARC Component” – November 2014

Project Completion Report of SPGR Coordinated Sub-Project “Farming Systems Research and Development for Farmers’ Livelihood Improvement”, BARC Component, November 2014

Compiled PCR of SPGR Coordinated Sub-Project “Farming Systems Research and Development for Farmers’ Livelihood Improvement” November 2014

Development and Up scaling of Integrated Pest Management Technologies in Vegetable Crops, November 2014

Project Completion Report on Collection, Characterization and Utilization of Rice, Minor Cereals and Chili in Bangladesh, Under AFACI-IMPGR project, November 2014

Catalogue on Rice, Minor Cereals and Chili Germplasm Collected in Bangladesh: under AFACI-IMPGR project (Volume - I), December 2014

Training Manual on “Agricultural Technologies for Adaptation to Climate Change”

TTMU

ToT of Mango Production for Agriculture Officers, DAE, TTMU, 01 June 2015.

ToT of Mango Production for Sub Assistance Agriculture Officers (SAAO), DAE, TTMU, 02 June 2015.

ToT of Potato Storage in Traditional Method for Agriculture Officers, DAE, TTMU, 7 June 2015.

ToT of Potato Storage for Sub Assistance Agriculture Officers (SAAO), DAE TTMU, 8 June 2015.

ToT of Production Technology of Major crops for Agriculture Officers, DAE, TTMU, 16-18 June 2015.

Fisheries

Project Completion Reports (PCR) of Coordinated Sub-project on addressing climate change on fisheries sector through community based technology identification and adoption in the fragile aqua ecosystems of Bangladesh (BARC and SAU components).

Project Completion Reports (PCR) of Gene banking of improved broodstocks of Indian Major Carps (catla, rohu and mrigal) and development of breeding technique of three threatened species (mohashol, bagair and baim)

Livestock

ELISA Based Anthrax Antibody Titer in Cattle Induced by Locally Prepared Anthrax Vaccine Originated from Sterne F-24 Strain in Bangladesh. *Microbes and Health*, January 2015, 4(1): 36-38.

Factors associated with repeated outbreak of anthrax in Bangladesh: qualitative and quantitative study. *J. Adv. Vet. Anim. Res.*, June 2015, 2(2): 158-164.

Investigating infectious and zoonotic diseases of street dogs in the residential area of Bangladesh Agricultural University. *Bangl. J. Vet. Med.* (2015). 13 (1): 57-63.

Morphologic and molecular investigation of schistosomes from the mesenteric vein of slaughtered cattle. *IOSR J. Agril. and Vet. Sci. (IOSR-JAVS)*, 8(4) Ver. III (Apr. 2015): 47-53.

Gene Bank Submissions: *M. tuberculosis* and *M. bovis* (TB): 14 Seqs. FMD Virus: 11 Sequences

SPGR Subproject Completion Report on “A Coordinated project on the Surveillance of Important Infectious, Zoonotic and Emerging Diseases of Livestock and Poultry in Bangladesh” (BARC Part), November 2014.

SPGR Subproject Completion Report on “Development of an effective PPR vaccine seed from local isolate and its molecular characterization” (BARC Part), November 2014.

Proceedings of the Workshop on “The Review of Livestock Research and Future Research Plan Preparation”, June 2015.

Computer and GIS

Presentations were made by Director (Computer & GIS) at annual PI meeting of ATIN project of AFACI held in Indonesia and 4th GIS workshop held at AEEA, Gulshan, Dhaka.

Crop calendar for 5 (five) crops Boro, Aus and Aman rice, Wheat and Mustard have been published.

AERS

M.M.U. Molla, S. A. Sabur and I. A. Begum. 2015. Financial and Economic Profitability of Jute in Bangladesh: A Comparative Assessment. *The Journal of Agriculture and Natural Resources Sciences*. 2(1): 295-303. Journal homepage: <http://www.journals.wsrpublishing.com/index.php/tjanrs>. ISNN:2383-238X.

M.M.U. Molla, S. A. Sabur and S. Akhtar. 2014. Current Scenario of Jute Sector in Bangladesh: Domestic and World Perspective. *International Journal of Business, Social and Scientific Research*. Vol. 2, Issue: 2, Page:

136-144. Available at <http://www.ijbssr.com/currentissueview/14013066>. ISSN: 2309-7892.

M.M.U. Molla, S. A. Sabur and M. J. Alam. 2015. Relationship between World and Domestic Prices of Raw Jute in Bangladesh: A Cointegration Approach. *The Journal of Agriculture and Natural Resources Sciences*. 2(1): 304-311. Journal homepage: <http://www.journals.wspublishing.com/index.php/tjanrs>. ISNN: 2383-238X.

IV. ADMINISTRATION AND FINANCE

ADMINISTRATION

Governing Body Meeting

The Second Governing Body (GB) meeting was held on 19 March 2015 in the BARC conference room. The meeting reviewed the achievement and implementation of the decision of the first GB Meeting. The meeting discussed among others the draft guideline of Agricultural Research Facilitation Award 2015; matter relating to allowances of



Second Governing Body Meeting held at BARC

training and other allowances, honorarium of NARS institutes; apprised the achievements attained by Sponsored Public Goods Research (SPGR) sub-projects, human resource and infrastructure development, future investment in agricultural research; and last two years achievements of the NARS institutes.

Executive Council Meeting

The 12th, 13th, 14th and 15th meetings of Executive Council of BARC were held on 1st October 2014, 9th March, 18th May and 22nd June of 2015 respectively in the BARC conference room. The 12th meeting considered among others the approval of the recommendation of the promotion and recruitment committee-2 of BARC, time extension of 36 SPGR Sub-projects under PIU-BARC: NATP Phase-1, extension of retirement age of the scientist of the NARS institutes, and research proposals and budget of 2014-15 of Bangladesh Institute of Nuclear Agriculture and Soil Resource Development Institute. The 13th meeting discussed among others the finalization of guideline of Agricultural Research Honouraria Medal 2015; matter relating to allowances of training and other allowances, honorarium of NARS institutes, and the

research proposals and budget of 2014-15 of Bangladesh Livestock Research Institute, Bangladesh Fisheries Research Institute, and Cotton Development Board. The 14th meeting considered among others the approval of the recommendation of the promotion and recruitment committee-2 of BARC and reconstruction of promotion and recruitment committee-1,2,3 of BARC; redetermination of promotion and recruitment criteria; strengthening of agricultural technology activities; and the



A view of Executive Council Meeting held at BARC

research proposals and budget of 2014-15 of Bangladesh Livestock Research Institute, and Bangladesh Forest Research Institute. The 15th meeting considered among others the approval of the recommendation of the promotion and recruitment committee-2 of BARC; redetermination of Self Assessment of Report (SER) format of NARS scientists, and research achievements of 2012-2013, research progress of 2013-2014 and research programmes and budget of 2014-2015 of Bangladesh Tea Research Institute, Bangladesh Sugarcane Research Institute, and Bangladesh Rice Research Institute

Appointment/Promotion/Retirement

The following officers and staff have been promoted during the period:

- Mr. Aminuzzaman, Principal Training Officer has been promoted to Director (Manpower and Training) and joined on 21 May 2015
- Dr. Mian Sayeed Hassan, Principal Scientific Officer (Crops) has been promoted to Chief Scientific Officer (Crops) and joined on 21 May 2015.
- Mr. Lokman Hossain has been promoted to Assistant Director (Audit) and joined on 15 November 2014.

The following staff have been promoted/appointed during the period:

- Mr. Md. Al-Amin has been appointed as Auditor and joined on 29 October 2014.
- Mr. Md. Shah Alam, Stenographer-cum-Computer Operator has been promoted to Head Assistant and joined on 2 November 2014.
- Mrs. Rahima Khatun, MLSS has been promoted to Daptari and joined on 23 October 2104.

FINANCE

Bangladesh Agricultural Research Council (BARC) is the apex body of the National Agricultural Research System (NARS) comprising 12 national agricultural research institutions. As per the BARC Act 2012, it has the mandate to develop priorities in agricultural research, allocate resources and function as a coordinating body to improve the overall research activities of the NARS. BARC receives funds from Development and Revenue Budgets of the Govt. to conduct its annual mandate activities like research management, coordination, monitoring, evaluation, technology transfer and manpower development and improvement of the production of Rice, wheat pulses, etc. In this respect BARC's Finance Unit prepares the MTBF budget and financial plan of medium term activities and accordingly disburses fund for achievement of the goal. It keeps all the

record of expenditure incurred during the year and reports to the Ministries, CAO, IMED, Development Partner and other Govt. Offices in time. It also reconciles the Accounts with CAO to prepare the final accounts which is submitted before the Public Accounts Committee (PAC) of the National Assembly.

Budgeting and Expenditure Control

The government has implemented Medium Term Budgetary Framework (MTBF) for all the Ministries including Ministry of Agriculture and its Division, Bodies and Corporations since 2005-06. Accordingly, BARC prepared budget in the form of MTBF for Revenue Head and Development Projects and submitted to the Ministry of Agriculture for approval.

Fund Release/Disbursement

BARC makes proposal for the release of fund from the Govt. on quarterly basis as per approved annual allocation of Budget. In the Financial year 2014-2015 BARC received Tk. 1537.90 lakh for Salary and allowances, Core Research, Technology Transfer, manpower development and operational fund. To implement these activities funds were released to the Agricultural Research Institutes (ARI's) and associated organizations according to the budget plan. The overall financial progress made during the FY 2014-15 is as follows:

a) Financial progress under Revenue Budget:

Sl#	Line items	FY 2014-15		Achievement%
		Budget	Expenditure	
1.	Pay of Officer	213.00	199.250	93.54%
2.	Pay of Staff	190.00	176.800	92.63%
3.	Allowances	416.55	387.460	93.01%
4.	Research Expenses	140.00	138.00	98.57%
5.	Manpower Development/Training	92.00	92.00	100.00%
6.	Utility	120.00	120.00	100.00%
7.	Other operational	88.05	87.85	99.77%
8.	Contributory Provident Fund (Govt. part)	40.30	37.60	93.30%
9.	Repair and Maintenance	33.00	33.00	100.00%
10.	Benevolent Fund, Leave Salary & Gratuity	206.00	206.00	100.00%
11.	Capital Expenditure	6.00	6.00	100.00%
12.	Total=	1544.90	1483.96	
13.	(-) Self Income	7.00	7.00	
		1537.90	1476.96	96.04%

b. Research Programmes/Projects

BARC has implemented 37 no's of research projects activity during the year 2014-15 under it's scheduled

research institutes and associated organizations. The financial progress of the research activities are as follows:

SI #	Name of Institute	No. of Research Projects	Financial Progress (Tk.)
1.	Sylhet Agricultural University	03	10,00,000
2.	Bangladesh Tea Research Institute	01	3,00,000
3	BAURES, Bangladesh Agricultural University	09	31,00,000
4	Soil Recourse Development Institute	01	4,00,000
5.	Bangladesh Agricultural Research Institute	13	44,00,000
6.	Bangladesh Institute of Nuclear Agriculture	01	3,00,000
7.	Bangabandhu Sheikh Mujibur Rahman Agril.Univ.	02	6,00,000
8.	Bangladesh Jute Research Institute	01	4,00,000
9.	Patuakhali Science & Technology University	02	5,67,500
10.	Hazi Danesh Science & Technology University, Dhaka	01	4,50,000
11.	Bangladesh Rice Research Institute	02	7,00,000
12.	Bangladesh Cotton Development Board	01	3,00,000
	Total=	37	1,25,17,500
13.	Bangladesh Agricultural Research Council		12,82,500.00
	Grand Total		1,38,00,000.00

4. SPGR Sub Projects

National Agricultural Technology Project (NATP) is a world Bank/IFAD funded project implemented by Project Coordination Unit (PCU), Sponsored Public Good Research (SPGR) of Agricultural Research

support component under NATP is being implemented by BARC through Project Implementation Unit (PIU). BARC Head Quarter coordinated 16 sub-Projects under Sponsored Public Good Research (SPGR) in the financial year 2014-2015 in the different thematic areas of research.

Si #	Project#	Name of the Sub Projects (SPGR)	Fund disbursed up to Dec. 2014
	311	Coordinated Project on Soil Fertility and Fertilizer Management for crops and cropping pattern BARC Component	2,30,649.00
	309	Updating of Fertilizer recommendation through Interpretation of Research Results Generated by The NARS Institutes,	2,05,106.00
3	306	Coordinated Project on Arsenic in soil water plant System	85,985.00
4.	319	Coordinated Project on Contaminants and adulterants in Food chain and their migration BARC Component	1,92,000.00
5.	305	Carbon Sequestration in Soils of Bangladesh	76,504.00
6.	308	Assessment of Land Productivity and its enhancement through utilization of surface water in coastal area	0.00
7.	315	Coordinated Project on Water Management for enhancing crop production under Changing climate: BARC Component	1,94,163.00
8.	314	Coordinated Project on Improvement of Agro Forestry practices for better Livelihood & Environment. BARC Component	3,21,265.00
9.	303	Development and Validation of Integrated pest Management Technologies in Vegetable Crops	0.00
10.	317	Coordinated sub project on Characterization of Important Plant Genetic Resources BARI Component	0.00
11.	383	Coordinated sub project on Farming System Research and Development for Farmers livelihood Improvement: BARC Component	0.00
12.	318	Coordinated project on addressing climate change on fisheries sector through community based technology Identification and adoption in the fragile Aqua Ecosystems Bd. BARC Component	2,58,000.00
13	307	Coordinated Project onto the Surveillance of important Infections, Zoonotic and Emerging Diseases of Livestock & Poultry of BD	1,26,000.00
14.	184	Application of GIS for Farm Productivity Enhancement through land	4,57,834.00

		suitability assessment of Major Cropping pattern of BD	
15,	362	Development of an effective PPR Vaccine seed from local isolate and its molecular characterization	1,34,000.00
16.	402	Production of Documentary on Highlights of R & D Activities of NARS Institute	0.00

Accounting

Maintained accounts following standard accounting system keeping a well printed Cash Book, Ledger, Advance Register, Budget Control Register and other related books to record all transaction during the year accurately.

GoB Audit

GoB local audit department conducted audit of 2014-2015 and raised 10 numbers of audit objection. Broadsheet reply was sent to local audit department to resolve the said audit objection.

Settlement of audit objections

During the year 2014-15 a remarkable number of audit objections have been settled.

Sl#	Particulars	No.	Settled audit objection
1.	Revenue	22	5,40,12,000/=
2.	Development	81	5,46,69,000/=
	Total :	103	10,86,81,000/=

Reporting

BARC Finance section has kept all the record of expenditure incurred during the year and reported to the Ministry, IMED, CAO, Development Partner and other Government offices Monthly, Quarterly, Half yearly and annually for revenue budget, development and program.

Monitoring and Evaluation

Monitoring and Evaluation are the integral part of an effective planning and performance based budgeting plan became successful and the value for money was realized only when the proposed targets for outcomes/outputs were achieved. To attain the targets, BARC Finance section regularly maintained desk monitoring on the utilization of fund for planned activities including budgetary and expenditure control mechanism.

Reconciliation

BARC also reconciled the Accounts with CAO to prepare the Final Accounts which was submitted before the Public Accounts Committee (PAC) of the National Assembly.

Retirement benefits

During the year 2014-15, retirement benefits and CPF Payment made to the Officer's and Staff of BARC are shown below:

a) CPF Final payment:

1	Officer	6 - persons	Tk. 53,77,000.00
2	Staff	10 - persons	Tk. 30,17,000.00
		Total Tk.=	83,94,000.00

b) Gratuity payment:

1.	Officer's	12 persons	Tk. 1,87,00,000.00
		Total Tk.=	1,87,00,000.00

c) Leave Salary payment: Leave Encashment allowed to the Officer's and Staff during the year are as follows:

1.	Officer &	10 persons	Tk. 16,30,000.00
		Total Tk.=	16,30,000.00

d) CPF Loan:- CPF loan provided to the Officer's and Staff during the year is as follows:

	Officer	8 persons	Tk. 21,91,000.00
	Staff	54 Persons	Tk. 98,31,000.00
		Total Tk.=	1,20,22,000.00

Group Insurance

BARC undertook Group Insurance scheme for well being of its Officers and Staff for any unavoidable incident with Jiban Bima Corporation since 37 years.

We mourn at the loss of our two colleagues i) Late Rahamat Ullah, Office Assistant-cum-Computer Operator (ii) Late Muslem Uddin Mia, Security Guard during the year. We received an amount of Tk. 4,33,920/= as compensation under the Group Insurance from Jiban Bima Corporation for the aforesaid deceased and payment made to their nominees accordingly.

Professional Staff

Office of the Executive Chairman

Abul Kalam Azad, PhD, Executive Chairman
Md. Hussyam Uddin Parvez, PS to Executive Chairman

Crops Division

Md. Aziz Zilani Chowdhury, PhD, Member Director (Routine Charge) Chief Scientific Officer
Mian Sayeed Hassan, PhD, Chief Scientific Officer
S.M. Khorshed Alam, PhD, Principal Scientific Officer
AKM Mahbubul Alam, PhD, Principal Scientific Officer (on Lien)

Planning and Evaluation Division

Paresh Chandra Golder, PhD, Member Director
Md. Abdul Awal, PhD, Chief Scientific Officer (CC)
Md. Abdus Salam, PhD, Principal Scientific Officer

Natural Resources Management Division

Sultan Ahmed, PhD, Member Director (Current Charge)
Mohammad Shahjahan, PhD, Chief Scientific Officer (Forestry)
Md. Abdus Satter, PhD, Chief Scientific Officer (Soils)
Shaikh Mohammad Bokhtiar, PhD, Principal Scientific Officer (Soils)
Md. Bakhtear Hossain, PhD, Principal Scientific Officer (Soils)
Dr. Nazmun Nahar Karim, PhD, Principal Scientific Officer (Ag. Engg.)

Fisheries Division

Md. Kabir Ikramul Haque, PhD, Member Director

Nutrition Unit

Md. Monirul Islam, PhD, Director

Livestock Division

Shah Md. Ziqrul Haq Chowdhury, PhD, Member Director (Routine Charge) & Chief Scientific Officer

Agricultural Economics and Rural Sociology Division

A.S.M. Anwarul Huq, PhD, Chief Scientific Officer
Mosharraf Uddin Molla, PhD, Principal Scientific Officer

Technology Transfer Monitoring Unit

Mian Sayeed Hassan, PhD, Director (Additional Charge)
Fauzia Yasmin, PhD, Principal Scientific Officer

Agricultural Information Centre

Md. Rafique Mostafa Kamal, Director (Additional Charge)
Md. Abdul Mabin, Principal Librarian (Current Charge)
Shah Md Monir Hossain, Senior Scientific Editor
Afroza Anjum, Senior Reprographic Officer
Susmita Das, Senior Documentation Officer
Md. Alamgir, Graphic Designer (Current Charge)
Hosne Ara Ferdous, Bibliographic Officer (Additional Charge)

Computer and GIS Unit

Md. Abeed Hossain Chowdhury, Director
Hasan Md. Hamidur Rahman, Senior System Analyst
Md. Shohid Uddin Bhuiyan, System Analyst
Mihir Kanti Sarker, Data Entry Officer
Md. Ayub Hossain, Data Entry Officer
Md. S.M. Shah Alam, Data Entry Officer (Current Charge)
Md. Abdul Karim Bhuiya, Data Entry Officer (Current Charge)

Manpower and Training Unit

M. Aminuzzaman, Director
Md. Mustafizur Rahman, Principal Training Officer (Addl. Charge)

Administration and Finance Division

Paresh Chandra Golder, PhD, Member Director

Support Service Unit

Shaikh Mohammad Bokhtiar, PhD, Director (Addl. Charge)

Md. Abdul Mottakin, Deputy Director (Establishment)

KM Ali Haider, Assistant Director (Establishment)

Md. Nasir Uddin, Assistant Director (Store)

M Nazim Uddin, Senior Assistant Director (Proc), CC

Md. Ershad Ali, Executive Engineer, CC
Dalil Uddin Boshnia, Assistant Director (Common Service) (Addl. Charge)

Finance Unit

Ajit Kumar Chakraborty, Director (Finance), Current Charege

Md. Jashim Uddin Chowdhury, Deputy Director (Budget)

Md. Mahbubul Hassan, Sr. Assistant Director (Budget)

Md. Daloar Hossain Asstt. Director (Accounts) Asstt.

Md. Lokman Hossin, Assistant Director (Audit),

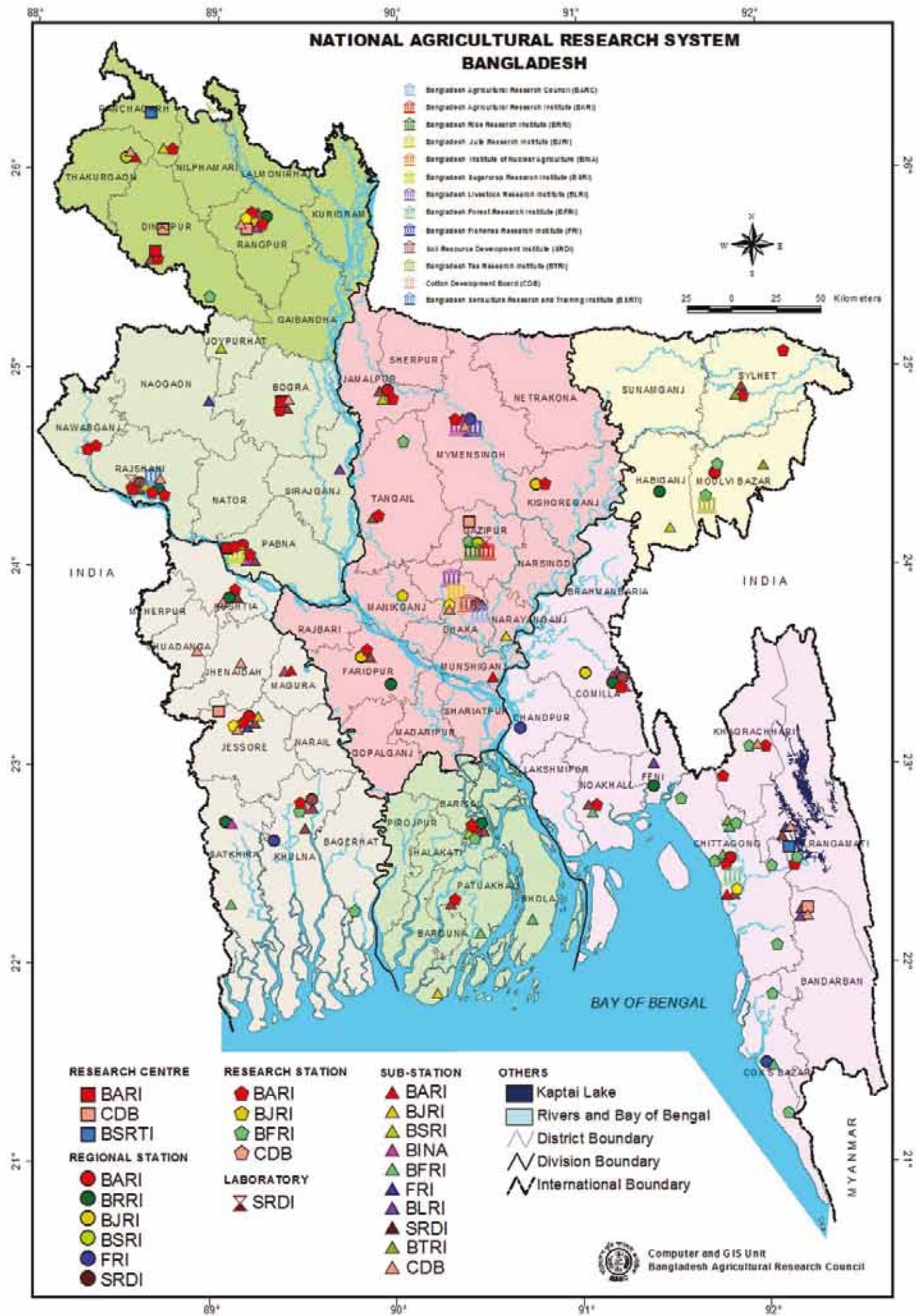
THE GOVERNING BODY
BANGLADESH AGRICULTURAL RESEARCH COUNCIL

1	Honorable Minister for Agriculture	Chairman
2	Honorable Minister for Fisheries and Livestock	Co-Chairman
3	Honorable Minister for Environment and Forests	Co-Chairman
4	Mr. Nazmul Hasan, Parliament Member, Kishoregonj-6	Member
5	Mr. Abdul Mannan, Parliament Member, Bogra-1	Member
6	Secretary, Ministry of Agriculture	Member
7	Secretary, Ministry of Fisheries and Livestock	Member
8	Secretary, Ministry of Environment and Forests	Member
9	Member (Agriculture), Planning Commission	Member
10	Vice Chancellor, Bangladesh Agricultural University	Member
11	Chairman, Bangladesh Agricultural Development Corporation	Member
12	Executive Chairman, Bangladesh Agricultural Research Council	Member
13	Director General, Department of Agricultural Extension	Member
14	Director General, Bangladesh Agricultural Research Institute	Member
15	Director General, Bangladesh Rice Research Institute	Member
16	Director General, Bangladesh Jute Research Institute	Member
17	Director General, Bangladesh Institute of Nuclear Agriculture	Member
18	Director General, Bangladesh Sugarcane Research Institute	Member
19	Director General, Department of Livestock Services	Member
20	Director General, Department of Fisheries	Member
21	Joint Secretary, Finance Division, Ministry of Finance	Member
22	Joint Secretary (Discipline and Law), Ministry of Public Administration	Member
23	Chief Conservator of Forests, Forest Department	Member
24	Dr. M.A. Hamid Miah, Liaison Scientist, IRRI Bangladesh, House#9, Road#2/2, Banani, Dhaka	Member
25	Dr. Qazi Khaliquzzaman Ahmad, Chairman, Palli Karma-Sahayak Foundation, PKSF Bhaban, Plot-E, 4/B, Agargaon, Dhaka	Member
26	Professor Dr. M. Nurul Islam, BUET, Flat-7, Minakkhi Apartment, House#27, Road# 12A (New), Dhanmandi, Dhaka	Member
27	Mr. Motahar Hossain Mollah, President, Bangladesh Krishok League, Kapasia, Gazipur	Member
28	Mr. A.K.M. Azad, Proprietor, A.M. Traders, Globe Center, 28/1 Indira Road, Farmgate, Dhaka	Member
29	Dr. Mahabub Hossain, Adviser to Executive Director, Bangladesh Rural Advancement Committee, BRAC Center, 75, Mohakhali, Dhaka	Member
30	Member Director (Administration & Finance), BARC	Member Secretary

THE EXECUTIVE COUNCIL
BANGLADESH AGRICULTURAL RESEARCH COUNCIL

1.	Executive Chairman, Bangladesh Agricultural Research Council, Dhaka	Chairman
2.	Director General, Bangladesh Agricultural Research Institute, Gazipur	Member
3.	Director General, Bangladesh Rice Research Institute, Gazipur	Member
4.	Director General, Bangladesh Jute Research Institute, Dhaka	Member
5.	Director General, Bangladesh Institute of Nuclear Agriculture, Mymensingh	Member
6.	Director General, Bangladesh Sugarcrop Research Institute, Ishurdi, Pabna	Member
7.	Director General, Bangladesh Livestock Research Institute, Savar, Dhaka	Member
8.	Director General, Bangladesh Fisheries Research Institute, Mymensingh	Member
9.	Director, Bangladesh Tea Research Institute, Srimongal, Moulvibazar	Member
10.	Director, Bangladesh Forest Research Institute, Chittagong	Member
11.	Director, Soil Resource Development Institute, Dhaka	Member
12.	Director, Bangladesh Sericulture Research and Training Institute, Rajshahi	Member
13.	Executive Director, Cotton Development Board, Dhaka	Member
14.	Executive Director, Krishi Gobeshona Foundation, Dhaka	Member
15.	Member Director (Crops), BARC	Member
16.	Member Director (Planning and Evaluation), BARC	Member
17.	Member Director (Natural Resources Management), BARC	Member
18.	Member Director (Agricultural Economics and Rural Sociology), BARC	Member
19.	Member Director (Livestock), BARC	Member
20.	Member Director (Fisheries), BARC	Member
21.	Member Director (Administration and Finance), BARC	MemberSecretary

NATIONAL AGRICULTURAL RESEARCH SYSTEM BANGLADESH



Computer and GIS Unit
Bangladesh Agricultural Research Council